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VOLUME 58 JUNE 18, 1915 NUMBER 25

Contents

*Illustrated.

It seems that the measure which has been pending in the Illinois legislature to limit the length of freight trains finally has been killed. It originally prohibited the railways from running trains of more than fifty cars. The roads conducted a vigorous campaign against this provision, both at Springfield and in the newspapers of the state. When the labor lobby saw the fifty-car bill could not be passed it substituted a measure limiting the length of trains to seventy-five cars. This at one time received 78 votes in the House, and it looked as if it might be passed; but when it came up for third reading it was defeated, 61 to 7. The labor lobby has introduced train-limit bills in nineteen states this year; and up to date it has been defeated in every state. The hardest fight for legislation of this kind was made in Illinois, and the final complete defeat of it there is a strong indication that it will never be possible to get it passed in another state.

Train Limit Bill Defeated

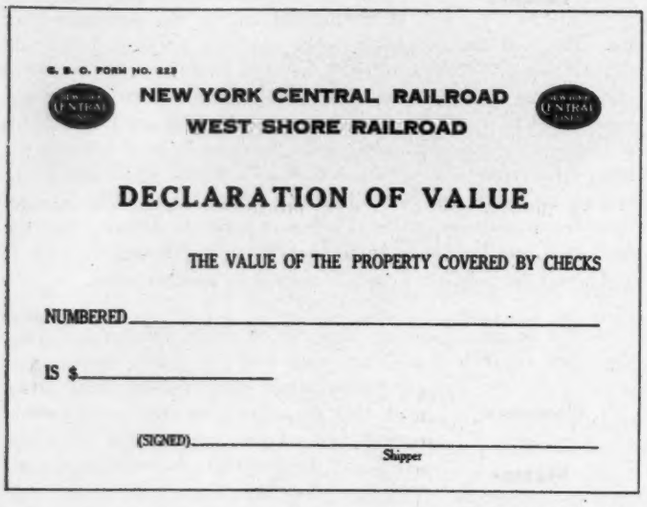
Station baggage men say that the "kickers" against declaring the value of their trunks are very few—as might, perhaps, be expected, when one considers that, after all, this declaration is only a reasonable application of the common law, long settled. If the passenger is well enough informed about the value of the property in his trunk to be able to make a reasonable estimate without stopping to calculate, he need be delayed not more than a minute. It is the railroad, rather than the passenger, who has cause for complaint; for at large stations, where, at best, many passengers will be slow, the checkers have had to be provided with considerable clerical assistance. The Interstate Commerce Commission's declaration about the crime of misstating value appears to have been the cause of a good deal of unnecessary comment. Indeed, the Washington correspondent of the New York World says that he has already been told, at the office of the commission, that a passenger is not bound to declare the full value of his property. As in any other form of insurance, he has a right to insure for less than full value. Jewelry salesmen say that their trunks, often worth several thousand dollars, are regularly insured by policies covering all risks, not only on the cars but at hotels and all places except the owner's store. It is not likely that the commission or the courts would compel double insurance. Making the value low, as a basis for insurance against loss, is a different thing from misstating it for the purpose of securing a reduced rate for transportation. The misdemeanor clause in the commission's report had in view, no doubt, such cases as declaring silk to be no more valuable than cotton, so as to secure a low freight rate. Freight rates are made higher on valuable goods, on the theory that the transportation is worth more to the owner; but in the baggage car the railroad is willing to carry the rich passenger's trunk and the poor passenger's at the same rate. If the owner of a trunk containing diamonds desires to have the carrier assume the large risk of the loss of that trunk, he is rightfully required to pay insurance; and if he prefers to bear a part of the risk himself, it is only reasonable to allow him to do so.

Insurance of Baggage

To write down the value of a piece of baggage and affix a signature to the statement need not take over half a minute; and not over a minute, even if one of the modern six-figure check numbers be added. But besides brevity there is a marked advantage in simplicity; and there are degrees of simplicity. The blank used by the New York Central is reproduced below, two-thirds actual height and width. The only things that detract from its simplicity are the printer's reference line and the two oval trade-marks; and if the advertising agent should claim that the trade-marks do not at all affect the passenger's eye or nerves, or mind, it would be difficult to dispute him. Examining the blanks of two other prominent roads, it will be found that they

Baggage Declaration Blanks

contain 11 and 17 lines, respectively, while yet they provide for no more information than is provided for here. It is natural enough to call a matter of this kind a trifle, hardly worth attention; but it is to be remembered that in transactions which are consummated in a few seconds, apparent trifles often count.



N. Y. C. FORM NO. 223

NEW YORK CENTRAL RAILROAD
WEST SHORE RAILROAD

DECLARATION OF VALUE

THE VALUE OF THE PROPERTY COVERED BY CHECKS

NUMBERED_____

IS $_____

(SIGNED)_____
Shipper

Moreover, this declaration is a part of a contract. The passenger cannot afford to treat it as a trifle; and if time is to be saved it is worth while to keep out of sight everything that would tend, unnecessarily, to make him hesitate a second in signing the declaration.

Morris & Essex and the Lackawanna

The Morris & Essex forms the eastern end of the Delaware, Lackawanna & Western, running from Hoboken on the Hudson to Phillipsburg, N. J., and from Denville to West End Tunnel, 118 miles. It was chartered in 1835, and 50 odd miles of road opened in 1854, and completed to Phillipsburg in 1866. There is $15,000,000 stock outstanding, and the property was leased to the Delaware, Lackawanna & Western in 1868, in perpetuity. The lease provides that 7 per cent shall be paid on the stock by the Lackawanna, and that an additional 1 per cent, making 8 per cent in all, shall be paid when the gross earnings of the Morris & Essex have reached a certain figure. The Delaware, Lackawanna & Western owns comparatively little of the outstanding stock, most of it being owned by individuals, trust companies and estates. The Lackawanna has never paid more than 7 per cent to Morris & Essex stockholders. A committee has now been formed with the president of the Metropolitan Trust Company as chairman, which has brought suit against the Lackawanna, claiming that 8 per cent should have been paid for a number of years back. This committee is also asking proxies from stockholders, with the purpose of electing a board of directors not identified with the Delaware, Lackawanna & Western. As to whether or not the accounting should have shown gross earnings sufficient to compel the Lackawanna to pay 8 per cent is a question which will be decided when the trial takes place. The propriety, however, of an independent board of directors which will represent Morris & Essex stockholders' interests and not Delaware, Lackawanna & Western stockholders' interests appears to be hardly a matter that can be questioned. In this case the Morris & Essex stockholders' interests are directly opposite to those of the Lackawanna's. The Morris & Essex stockholders want as large a rental as possible, the Lackawanna as small a rental as possible. There is no question apparently of the management of the property which belongs to the Lackawanna in any case under the terms of the lease. It is one of those things where it would appear to be better practice for the leasor to have a wholly independent board of directors, than to have its own directors or officers acting in dual capacity where there is a possibility of diametrically opposed interests presenting questions for settlement. The trouble in this case is that there is no provision in the lease for paying the directors or for maintaining a separate office and bookkeeping force. This probably has been a fact which Lackawanna directors have used to justify to themselves their action. It will be particularly interesting to follow the attempt of the new committee to arouse stockholders to the situation and the success or lack of success which is met with will be illuminating as to the possibility of getting railroad stockholders to take a more active interest in the affairs of their company.

THE HANDLING OF L. C. L. FREIGHT

WHILE less-than-carload freight forms only about 4.3 per cent of the total tonnage handled, the revenue derived therefrom is a very considerable part of the total income of the railways. This business is, therefore, attractive from the standpoint of the traffic solicitors, although the operating department finds it expensive to handle. In consequence, many operating officers are giving a great deal of attention to means of reducing the cost of handling l. c. l traffic. Houses for the receipt and delivery of less-than-carload freight must be located close to the centers of business in cities and therefore on high-priced land. In most cases those now in existence were built years ago and are receiving more freight than can be handled economically, while the high price of adjoining property makes enlargement difficult and frequently impracticable.

E. H. Lee, vice-president of the Chicago & Western Indiana, has estimated (*Railway Age Gazette*, April 3, 1914) that the fixed charges alone amount in some instances to as much as $1.50 per ton of freight handled. This condition is prompting careful and extensive studies of the design of freight houses to secure the maximum capacity, and thus keep down overhead charges, while at the same time securing economical operation. The increasing use of motor trucks and other mechanical appliances is also beginning to be reflected in the design of freight houses.

The less-than-carload freight gives rise to far more than its proportion of claims for loss and damage. This arises largely from improper packing and marking of the individual packages, from rough handling to and from the cars and from improper loading in the cars, all of which the roads are endeavoring to eliminate.

Another important phase of this subject is the consolidation of less-than-carload freight shipments to secure the maximum practicable car loading. From the nature of the traffic it cannot be expected that its loading will ever approach that of carload freight. At the same time investigations on several roads have shown that it can be materially increased. By an aggressive campaign one road raised the average tonnage of l. c. l. freight per car for all stations from 4.6 tons in 1909 to 6.8 tons in 1914, and estimates that for the first nine months of the present fiscal year it has saved over 14,000 car movements as compared with the same period in the previous year.

One of the most direct opportunities for improvement lies in the reduction of the labor cost of handling at the freight house. In a report just made to the City Council of Chicago, John F. Wallace states that the labor cost of handling l. c. l. freight at 19 houses in Chicago varies from $0.29 to $0.66, with an average of about $0.475. The bonus system and other means for improving the efficiency of the labor employed have been adopted at a number of stations, while the installation and economical use of motor trucks and similar equipment also effects a reduction in the labor required.

The above examples illustrate the importance of this subject. To stimulate discussion of the subject we announce a contest on The Handling of L. C. L. Freight, to include all phases of this problem, from the time the freight is received

at the door of the freight house until it is delivered to the consignee at destination. While general discussions are solicited, descriptions of improvements in operation actually made and detailed statements of the results secured will receive special attention. Prizes of $50 and $35 will be paid for the two best papers received, the award being based on the completeness of the discussion and the practicability of the ideas presented. All other papers accepted and published will be paid for at our regular space rates. Contributions should be sent to the Editor of the *Railway Age Gazette,* 608 South Dearborn street, Chicago, and must be reecived before August 1, to be considered by the judges.

CREDIT—A NECESSARY ASSET

RIGHTLY understood the question and answer from the Wall Street Journal, reprinted elsewhere in this issue, throws light on one phase of the railroad problem which is probably less understood by the majority of legislators, and even by the Interstate Commerce Commissioners, than any other. The holder of Missouri, Kansas & Texas preferred stock who writes to the Wall Street Journal states substantially correctly the present very good showing which is being made in the operation of that property and winds up with the query: "With all these rugged facts, will the 'Board' dare to pass a dividend on the preferred stock this year?"

The Wall Street Journal points out the reasons why there is very small chance that the Katy will pay any dividends this year on its preferred. The company's credit must be restored, and this is as necessary as was the increase in its earning power. Credit is not only intangible, but of such a volatile nature that to discuss it even may destroy it. Yet credit is an asset just as vitally necessary to the operation and development of a railroad as the rolling stock or the roadway.

The Missouri, Kansas & Texas case is different in particulars from that of other roads of course. The present showing as compared with a year ago is better than the majority of roads are making. There are peculiar difficulties in the way of getting a specific vehicle for long term financing. There is illustrated, however, in this case the principle, the understanding of which is so necessary to an intelligent discussion of American railroad problems.

In a great majority of rate cases decided by the Interstate Commerce Commission, railroad credit never enters into the consideration of the case, and yet in the aggregate the Interstate Commerce Commission rate decisions vitally affect railroad credit. In the 1914 rate case one of the commissioners touched in a somewhat curious way on one of the points that is brought out in the Missouri, Kansas & Texas situation when he asked a railroad president whether he would tell a banker from whom he was going to try to borrow money how bad the earnings of the railroad were. In other words, what he wanted to know was whether a railroad president would make the same exhibit in trying to borrow money as was being made to the Interstate Commerce Commission in asking for higher rates. Pretty surely there were railroad managers who could have put before the Interstate Commerce Commission facts more convincing than any of the generalizations which were introduced as evidence, had it been possible to do so without at the same time injuring the credit of his road or of other roads.

As a railroad executive said recently, probably no one of the Interstate Commerce Commissioners ever raised $100,000 for business purposes in his life. The first plan for the reorganization of the Chicago, Rock Island & Pacific without receivership proceedings fell through, because when President Mudge and some of his operating officers appeared before the bankers who were to underwrite the plan, they could not truthfully say that in their opinion the road would earn the amount necessary to make reasonably sure of a preferred stock dividend. That was not a case of credit, but a case of earning power, and is just the converse of the Missouri, Kansas & Texas case. On the other hand, the present Rock Island situation is one in which credit plays a very important part. The Missouri Pacific is another instance.

Eastern roads especially are beginning to show material improvement in gross earnings. Many roads which had not shown a favorable comparison with the corresponding period of a year before for more than 15 months, showed a gain in May, 1915, as compared with May, 1914. Forces of train men as well as enginering and mechanical forces have been cut to the very minimum. As gross increases, expenditures for maintenance and renewals will be made on a more liberal scale than was possible last year. The Pennsylvania recent rail order is a case in point. The train crew and other forces in the transportation department will necessarily have to be increased and a considerable part of the gains which appear probable in gross will be absorbed in expenses, but not all it is to be hoped. Many roads ought to begin to show a larger net operating income. But beside the showing of earning power to pay interest charges on an issue of new securities for capital expenditures, there must also be a willingness on the part of the bankers to buy these securities. This is a point that is so hard apparently for legislators and theoretical students of railroad affairs to understand. There must be that indefinable something which supplies the incentive for the investment of money in railroads, and broadly that incentive has to be either a hope of very considerable profits or an assurance of a fair return and a reasonable guarantee against the discontinuance of this return. It is one thing to argue that bankers ought to have been glad to finance the Rock Island and quite another to put the deal through. Neither commissioners nor legislators can change a static force into a dynamic force; that is, they cannot make investors actually put their money into some particular enterprise; but what they can do and should do is to recognize that certain conditions are conducive of this change and certain other conditions are unfavorable to it.

PROGRESS OF THE BLOCK SYSTEM

NO less than 76 railroads report to the Interstate Commerce Commission that all of their passenger trains are run under the space-interval system, as will be seen by the abstract of the commission's latest bulletin, printed on another page. That is to say, 76 roads report that all of their passenger tracks excepting, in a few cases, lines on which only one engine is in service—are operated by the block system. In addition to these there are 20 others which report 90 per cent or over, thus operated, making a total of 96 roads reporting 90 to 100 per cent.

This is a gratifying exhibit. Progress in this field until recently has been slow, but at last it seems to be sure. The totals of the government tables are approaching the 100,000-miles mark and evidently the time is not far distant when passenger traffic on the important lines everywhere throughout the country will have the benefit of this system. That the principle of the space interval is well appreciated is evident from the fact that block signals are used on two or three hundred miles of road devoted exclusively to freight traffic; and that the good results on all sorts of lines are substantial is evidenced by the statistics of collisions for the last few years, showing a striking reduction in the losses from this cause. Some of these statistics were given in the *Railway Age Gazette* for May 21 last, page 1036. Another significant item, though it fills only an inch, is that printed in this issue, to the effect that on a very busy division of the Baltimore & Ohio the derrick and tool cars recently had a complete rest for 45 days. This record could be matched on other roads, no doubt. When the "A B C" block system was in use on the Northern Pacific, it was credibly reported that on one division the wrecking car was left standing unused for so long a time that it developed flat wheels!

The number of 100-per cent items in the table published today is about 20 per cent greater than the total in the table issued one year ago. Those in that report numbered only 50,

and the 90-and-above only 16. The increase, however, is not quite so large as it appears, for the Grand Trunk this year is divided into 13 items, while last year the total for the system was consolidated in one item. There are a few other similar cases, making the net increase in 100-per cent items, as stated above, about 20 per cent. Again, it is to be borne in mind that this year there are many new names in the table, including some electric roads; and that on these, while the statistics are new, it may be that the signaling is not. But, making all allowances, there still remains a gratifying increase in the number of roads which believe in the space interval through thick and thin; and this gratification has a substantial basis, notwithstanding the further allowance that must be made, namely, that on some of these 100-per cent. roads the space interval is not much used except for the protection of passenger trains. The use of the space interval in any degree, at any time, is ground for satisfaction, for it has a constant educational effect; and sooner or later this leads to the further introduction and the perfection of the system. The government statistics (Table No. 4, manual block signal practice) afford further gratification in the column headed "permissive signaling forbidden," in which there are 32 items, aggregating 5051 miles of road.

This great improvement costs money, of course. The difficulty of raising money under the present almost impossible conditions is the reason why a greater extension of the best signaling cannot be reported at the present time. It will be noted that the figures of two roads, the Southern Pacific and the New York, New Haven & Hartford, account for 87 per cent of all the increased mileage shown, in the smaller table, under the head of non-automatic signaling. On both these roads this extension has been mostly made on lines not classed as important parts of the system. In other words, the officers have improved their service, not because of losses by wrecks, temporarily stirring the directors' feelings, but from a clear understanding of the permanent principle; the principle that the space interval is fundamentally rational while the time interval can never be other than patch-work. If these officers had shortsightedly drawn a balance between the cost of maintaining safe methods and the cost of wrecks under the old methods they might have decided not to make the improvement. By shutting one's eyes to the future this is often possible. On the New Haven road the change added to the current expenses about $1,000 a month, and that road just now has no thousand-dollar bills to throw away; but, as has been said, the officers evidently decided to do what was best for the service, not what would be best temporarily to sustain the cash balance.

NEW BOOKS

The Panama Canal. By Reuben E. Bakenhus, civil engineer, United States navy; Harry S. Knapp, captain, United States navy, and Emory R. Johnson, professor of transportation and commerce, University of Pennsylvania. Size 6 in. by 9 in., 257 pages, with maps and illustrations. Bound in cloth. Published by John Wiley & Sons, Inc., New York City. Price $2.50.

This book includes under one cover five papers originally published in the Proceedings of the United States Naval Institute. In their preparation the authors have endeavored to present a comprehensive view of the canal, its history, the manner in which it was built, and its place in commercial and international activities. One-half of the book is devoted to the construction of the canal, including discussions of the reasons prompting the adoption of the present location and the lock rather than the sea level type. The chapter on the standing of the canal in international law, including copies of the various treaties concerning it, and the discussion of its commercial importance and its effect on lines of travel, will also be of interest to railway men. In an appendix is given the President's proclamation of last year, assuring the neutrality of the Canal Zone. The book is accompanied by six maps, showing the features of the canal in detail.

Letters to the Editor

STATE AND FEDERAL ACCIDENT-REPORT REQUIREMENTS

New York City.

To the Editor of the Railway Age Gazette:

Your correspondent "R. R. N. Y." in a letter published May 28, under the caption "The Government Accident Records," presumes that the railroads "are using their influence with the Washington authorities, through the committee of which Mr. Kruttschnitt is chairman"; and asks "Why should they not also use their influence with the state commissions?"

The American Railway Association Special Committee on Accident Statistics, in conference with W. J. Meyers, statistician of the Interstate Commerce Commission, arranged for a meeting with the representatives of the railway labor organizations, the National Association of Railway Commissioners, and representatives of the public service commissions of New York and Pennsylvania, at which the proposed accident forms and rules were fully discussed and conclusions were reached acceptable to all interests represented. It was obviously impossible to take up the preliminary steps with the commissions of 45 states, and our committee thought that with the approval and endorsement by the representatives of the National Association of Railway Commissioners, and of the public service commissions of two of the most important states in the Union, of what had been done, that they were making a very fair start, and that after a tentative conclusion had been reached, would be the proper time to submit the forms and rules, etc., to the railway commissions of all of the states that had commissions. The statistician of the Interstate Commerce Commission mailed copies of the revised draft of the rules and the proposed forms to all of the state railroad commissions, to public service commissions, and to all others interested, on May 17, with a request for further criticisms and suggestions.

It is therefore evident, from the above, that the co-operation of the state railroad commissions has been invited, and our committee hopes that the general adoption of the Interstate Commerce Commission's blanks for reporting accidents will result therefrom.

J. Kruttschnitt.

SIMPLE TRAIN AND ENGINE NUMBERS

Little Rock, Ark.

To the Editor of the Railway Age Gazette:

Is there any benefit to be derived from trains and engines carrying large numbers? I am sure it is not apparent from a despatcher's standpoint. The car service office and the general transportation clerk may secure a little advantage in being able to know off-hand just where a certain train runs, without having to consult the time cards, but it is doubtful if they rely on that to any degree now. Some tables show individual train and engine numbers as high as four figures; and when a despatcher in writing and sending an order has to spell out the train numbers two or three times, and add the long engine numbers, there is quite a little loss of time. How much easier and simpler to say and write train No. 1, engine 5, than train No. 1326, engine 7702.

Some local trains are run from, say A to B under No. 52, B to C as No. 54 and so on. What is there to prevent No. 52 being carried over the entire line?

C. H. A.

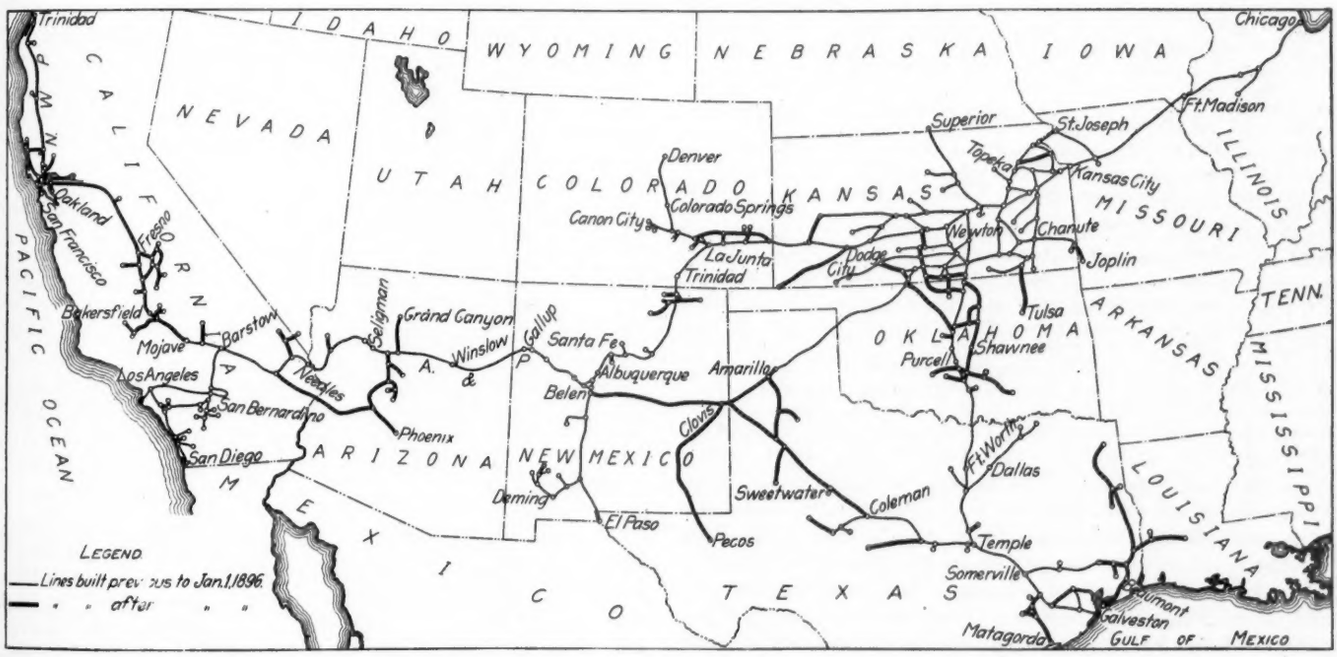
An Argentine Railway Record.—The Central Argentine recently made a record non-stop run. A special train of six cars, a total of 34 axles and 258 tons in weight, made the journey over the Rosario line of the Central Argentine, between Rosario and Retiro, Buenos Ayres, a distance of 189 miles. The run was made without a stop in three hours and 40 minutes, an average of 51 miles an hour.

Nineteen Years' Development Work on the Santa Fe*

Part 1—Outline of Methods by Which Property Has Been Developed and Physical Condition Improved

On January 1, 1896, the Atchison, Topeka & Santa Fe emerged from a receivership of two years' duration with 6,435 miles of line and with gross earnings for the preceding fiscal year of $28,851,841, resulting in a net deficit for the year of $4,433,380, after the payment of fixed charges. On January 1, 1915, nineteen years later, this road was recognized as one of the strongest in the United States, having over 11,000 miles of line, while its gross earnings for the fiscal year ending June 30, 1914, were $111,109,770, and its corporate income available for dividends and surplus was $20,183,965. Its record is made the more interesting by the fact that the gross operating revenues for the first nine months of the present fiscal year show an increase of $4,797,176, while its net corporate income shows an increase of $3,434,626 as compared with the same period last year, at a time when almost every other railroad is showing large decreases in both gross and net revenues.

The means by which this property has been developed from its earlier condition of weakness to its present position of strength, during a period when some of its closest competitors have become involved in difficulties of one kind or another, form a most interesting and instructive example of constructive and efficient American railroading. It will be the endeavor in this article to point out the more important policies underlying this development and the manner in which they have been applied to secure these results.



The Development of the Santa Fe Lines Since the Receivership

CONDITIONS LEADING TO THE RECEIVERSHIP

To understand fully the development which has taken place since the reorganization of the Santa Fe, it is necessary to review briefly some of the conditions leading to the receivership. The road was chartered in Kansas in 1859, but construction was not begun until nearly 10 years later. By 1873 the main line had been built from Atchison, Kan., west 471 miles to the western line of the state, and 38 miles of branches had also been constructed. In 1877, when William B. Strong was placed in charge of the property it had increased to 786 miles, nearly all of which was in Kansas. Mr. Strong was a man of wide vision, and he saw the opportunity for a system extending from the Great Lakes to the Gulf of Mexico and the Pacific coast, not only to reach these important sources of traffic, but to secure a widely diversified traffic. He, therefore, inaugurated at once a policy of active expansion. The main line reached La Junta, Col., in 1878; Albuquerque in 1879, and El Paso, Tex., and Deming, N. Mex., in 1881. The intention at that time was to extend to southern California over the general route now followed by the Southern Pacific, but this was blocked by the Southern Pacific interests building a line east from southern California. The Atlantic & Pacific was then acquired by the Santa Fe and the St. Louis & San Francisco jointly and construction started westward from Albuquerque, reaching the Colorado river at Needles, Cal., in 1883, where it met another Southern Pacific line built south from Bakersfield. An agreement was soon reached whereby this line of the Southern Pacific, from Needles to Mojave, Cal., was leased with an option to purchase. After the reorganization of the Santa Fe this line was secured in exchange for the Sonora line which the Santa Fe had built south from Benson, Ariz., to Guaymas, Mex.

During this time the Gulf, Colorado & Santa Fe was being built north from Galveston by local interests, reaching Fort Worth in 1881 and Dallas in 1882. In 1886 the Santa Fe secured control of this property and extended it north to a connection with its own line at Purcell, Okla., the following year. However, it was from 1885 to 1887 that there was the greatest activity in construction. In 1886 almost 1,700 miles of line were completed, 1,000 miles of branch line being built in Kansas alone. The extension from Pueblo to Denver was completed that year, while the line to Chicago was finished the following year.

This period was characterized by widespread construction work throughout the entire West. It was at this time that the Burlington and Rock Island extended to Colorado, the Southern Pacific

*This, the first of two articles, describes the causes leading to the receivership, the condition of the property at the time of the reorganization and the policies governing the building of extensions and the maintenance of the roadway and equipment. The second article will appear in next week's issue and will describe the means by which the traffic has been developed, the methods of operation and the resulting increase in earnings.

reached New Orleans, and the Northern Pacific, the Great Northern and the Canadian Pacific were pushing westward. All of these and other roads were also building correspondingly large mileages of branch lines. As a result there was over-extension, the country did not develop as fast as the roads, and the net earnings of the Santa Fe, in common with those of other roads, began to decrease rapidly. As a result of accumulated troubles Mr. Strong resigned in 1889 and the management was changed.

The succeeding management at once endeavored to recoup its earnings by engaging in a war of rate cutting. At the same time it secured control of the St. Louis & San Francisco and the Colorado Midland. These developments greatly complicated the already serious problem, and led to the receivership on December 23, 1893. This lasted for two years, during which time numerous improvements were made to the property, and the Colorado Midland was sold. The capitalization was readjusted and on January 1, 1896, the receivership came to an end and the property was placed in charged of the present management.

CONDITIONS OF THE PROPERTY IN 1896

At the time it came out of the receivership the property consisted of 6,435 miles of line extending from Chicago to Galveston, Denver, Albuquerque and El Paso, in addition to a joint interest with the St. Louis & San Francisco in the Atlantic & Pacific, then in receivers hands. Its condition has been well described by Charles S. Gleed, a director, in a booklet entitled, "The Rehabilitation of the Santa Fe Railway System" as follows:

"When the new directors and officers took charge the line from Chicago to Kansas City, which recently had been constructed in very great haste, was in bad condition and required extraordinary expenditures. The line extending from St. Louis toward Kansas City for about 70 miles had to be extended or sold. Many new lines in Kansas needed heavy improvement. The Atlantic & Pacific had to be bought and then rebuilt. The line from Needles to Mojave was a wretched piece of track.

"The new lines in Indian Territory and Texas were in the poor condition usual to new lines in the west. The equipment was inadequate and the buildings were nearly all of the temporary style characteristic of new lines. The Sonora and some other lines were operating at a loss. The St. Louis & San Francisco lines were in most primitive condition. The old main line from Kansas City to Denver and El Paso was the only line in good condition for the service which had hitherto been required of it. Practically all of these lines had been well built and greatly improved, considering the standards of that day and the requirements of the traffic, but they were in no condition to accommodate the high speed and the heavy traffic of the time at hand."

This was the condition of the property when the new management assumed control. President E. P. Ripley and his associates have been in direct and continuous charge since that time, which must be borne in mind, for it is of primary importance in a study of the reconstruction of the property. Too often managements have been changed in the midst of the difficulties following a receivership before they have had an opportunity to demonstrate their ability or the wisdom of their plans. Mr. Ripley and his associates have been given full and uninterrupted opportunity for the working out of the policies outlined by them at the outset.

THE BUILDING OF EXTENSIONS

One of the fixed policies of the present management has been the concentration of its entire attention on the development of the Santa Fe proper. One of its first acts was to dispose of its interest in the St. Louis & San Francisco and other properties not essential to the operation of the Santa Fe itself. The broadness of this attitude and the determination behind it are revealed by the early sale of the St. Louis, Kansas City & Colorado, a short line extending west from St. Louis about 70 miles. At the time the Chicago extension was built this line was bought with the idea of incorporating it into a line from Kansas City to St. Louis to give the Santa Fe an entrance to the latter city, but no work had been done upon the construction of the intermediate link. As there were already several other lines between these two cities, its construction would only serve to further divide the traffic moving between those points and create an economic waste of capital. For this reason the line was sold in preference to building the connecting link. While by this act the Santa Fe gave up its opportunity to secure an entrance into St. Louis with its large traffic, which has been regarded by some as a mistake, it prevented the diversion of interchange traffic to its competitors. On the other hand, the Atlantic & Pacific, owned jointly by the Santa Fe and the St. Louis & San Francisco previous to its receivership and operated as a separate property, was essential to the Santa Fe, and it was taken over by it directly on July 1, 1897.

The same strict policy of conservation of capital has been followed in making expenditures for extensions and for increased facilities. No attempt has been made to engage in competitive building with other lines or to invade territory already provided with transportation facilities, unless the entrance to San Francisco be so regarded, and this was secured by the purchase of a line already built and in operation. Rather, construction activities have been confined to the large area in the southwest without adequate transportation facilities. Even here, a very conservative attitude has been maintained and extensions have been built only to reach sources of traffic definitely known to exist or which gave promise of developing within a very few years. As a result, the mileage of unremunerative branch lines today is limited. In the same way short lines of proven traffic value have been purchased from time to time.

While the attitude regarding extensions has been conservative, the mileage has grown from 6,435 in 1896 to 11,092 on January 1, 1915, located in 13 different states, in addition to 594 miles owned jointly with other companies and 225 miles controlled through lease or the ownership of stock. It is instructive to note that the extensions built by the present management have followed very closely the lines laid down by Mr. Strong. Also, practically all of the lines built during the earlier administration have since proved their value from the traffic and strategic standpoints, evidencing the foresight displayed at that time. As a result the system now comprises main trunk lines extending from Chicago to Colorado, the Pacific coast and Texas, as well as from Texas to the Pacific coast, about which branch line feeders may be built as the country develops as has been done in Kansas, where the Santa Fe now has 2,817 miles of line and enters 74 of the 104 counties.

The policy of avoiding waste of capital by competitive building has also been avoided in numerous instances by joining with other roads in the construction and use of joint facilities essential to both. The most important recent instance of this nature is the co-operation with the Southern Pacific in the construction of the Northwestern Pacific along the coast north of San Francisco for nearly 300 miles. Rather than build another line, the Santa Fe uses the tracks of the Southern Pacific over the Tehachapi mountains for 67 miles, while it shares its tracks with the Salt Lake line for 90 miles over the San Bernardino mountains. Likewise when building second track between Chicago and Kansas City a few years ago, arrangements were made to combine the single tracks of the Alton and the Santa Fe into a double track for 20 miles near Joliet, Ill., while a similar arrangement was made with the Wabash for the joint use of 30 miles of tracks near Carrollton, Mo., so that each road secured the advantage of double track with practically no increased expenditure.

IMPROVING THE PROPERTY

As stated above, while in general the lines had been built well according to the standards prevailing at the time of their construction and the traffic then in sight, heavy grades were common and the facilities were inadequate in many ways when the new management took hold. Practically the only exception to this was the Chicago extension which had been built only a few years before with a maximum grade of 0.8 per cent to handle the relatively large amount of business collected by the network of lines west of Kansas City. Furthermore, the property had been allowed to run down during the years immediately preceding the receivership. Therefore, in addition to constructing extensions to reach new traffic, the new management had to reconstruct the existing property to enable it to handle a greater traffic more economically and to bring it up to the proper standards of maintenance.

Some of the most extensive improvement work has been connected with the reduction of grades. The main line to the Pacific coast crossed four ranges of mountains with ruling grades ranging from 1.8 per cent to 3.5 per cent. The most serious operating problems were presented on that portion of the line between Trinidad, Colo., and Albuquerque, N. Mex. When the line was first projected beyond Dodge City in 1878 it was planned to build directly southwest to Albuquerque, avoiding the Raton mountains. However, local Pueblo interests started building a line east from Pueblo along the Arkansas river, and the Santa Fe location was deflected to meet it at La Junta. The western extension was then continued south from this point, passing over Raton mountain with a 3.5 per cent grade on the north and a 3.3 per cent grade on the south slopes and a tunnel at the summit. Aside from making operations very expensive, these conditions led to very serious congestion and blockades which the construction of a second track only partially relieved, and for a number of years this portion of the line was regarded as limiting the capacity of the entire system. A similar, although less serious condition existed at Glorietta summit, 175 miles further south, while the grade line was badly broken with numerous 1.4 per cent grades all the way to Albuquerque.

To relieve these conditions a new low grade line was built from Belen, 30 miles south of Albuquerque on the El Paso line, east 345 miles to Amarillo on the Pecos Valley line, and the latter line was rebuilt into Wellington, Kans. With the exception of a 1.2 per cent. grade just out of Belen, on which helper engines are operated, the maximum grade on this line is 0.6 per cent each way to Kansas City, a distance of 928 miles. The immediate advantage of this cut-off and alternate main line which was placed in service in 1906, was an increase in the tonnage rating from 900 to 1,000 tons on the old line with considerable helper service, to 2,600 tons on the new. The congestion was also removed, while a considerable saving in the time of trains was also effected. In addition, because of its more southerly location, the new line escapes a large portion of the snow troubles of western Kansas and Colorado. All freight traffic between points east of Newton, Kans., and west of Belen, now moves over this new line, while in conjunction with the line completed last year across west Texas a 0.6 per cent grade is also secured from Belen to a connection with the Gulf lines at Coleman, Tex., and all traffic interchanged between the Gulf and Coast lines is sent over this cut-off, instead of moving through southern Kansas, as was formerly necessary.

Similar extensive improvement work has also been done west of Albuquerque. For the first 158 miles to Gallup, the original ruling grade of 1 per cent has been reduced to 0.6 per cent. Between Winslow and Needles the line was built originally with ruling grades of 2.6 per cent over the summits and 1.8 per cent elsewhere. These grades have now been reduced to 1.8 per cent and 1.4 per cent, respectively. In most instances this has been accomplished by the construction of a single track line on the lower grade for ascending traffic, leaving the old track on the heavier grade for descending trains. However, in one place east of Seligman, where a second track was required and the existing line was already on the desired grade, the unusual practice was adopted of building the new track on a 3 per cent grade for descending trains, thereby effecting a saving of over two miles in distance and a material reduction in the cost of the second track.

In the same way the grades southbound on the line from Newton, Kans., to Texas have been reduced to a maximum of 0.6 per cent to the crossing of the Red river, a distance of 330 miles. From this point to Temple, Tex., the original 1.25 per cent ruling grade still remains.

While not on so large a scale, similar improvements have been made over the entire system according to a carefully prepared program. When work has once been undertaken on one line it has been followed to completion. Only such work has been undertaken as time and the funds available permitted, and when only a limited amount of money has been available it has been devoted to completing the work on a certain mileage rather than distributing it in lesser amounts over a greater area and not completing the work anywhere. By concentrating attention in this way numerous improvements have been made in the way of minor grade reductions, etc., and the main and important branch lines have been improved materially with relatively small expenditures.

INCREASING THE FACILITIES

In this interval of 19 years large additions have also been made to the facilities. At the time of the reorganization only 16 miles of second track was in service. Today there is 975 miles. The line has been double tracked all the way from Chicago to Newton, Kans., 655 miles, while 300 miles of second track has been built west of Albuquerque. Counting the low grade line from Newton to Belen as second track, all but 475 miles, or 22 per cent of the line between Chicago and Barstow, Cal., where the Los Angeles and San Francisco lines separate, is double track. Terminals have also been enlarged. With two exceptions, the road owns its own terminals and it is not dependent on facilities leased from other roads.

While most of the terminals were secured by the earlier administrations the present management has made relatively large expenditures to secure adequate facilities at San Francisco and Kansas City. When the San Francisco & San Joaquin Valley railroad was taken over in 1900 it had limited terminal facilities which have been supplemented since that time at considerable expense.

The water problem is a serious one on all southwestern roads. During the winter of 1897, 43 per cent of the traffic across the desert east of Barstow, Cal., consisted of water and company coal. Relatively large expenditures have been made to develop reservoir and other water supplies, and while it is still necessary to haul water for several stations at isolated points the total amount has been very materially reduced, while the substitution of oil for fuel on locomotives as far east as Winslow, Ariz., has reduced the amount of fuel required on the Coast lines east of Barstow to an average of 14 cars daily.

MAINTENANCE OF WAY AND STRUCTURES

Intimately connected with the policy governing the construction of extensions and additional facilities has been that relating to the standards of maintenance. At the time of the reorganization large parts of the property were badly run down, while at the present time it is one of the best maintained properties in the country. This has been brought about primarily by the expenditure of liberal sums for maintenance regularly from year to year. This is shown most clearly by the fact that for the 19 years since the reorganization an average of 15.2 per cent of the gross operating revenues has been returned to the property in expenditures for maintenance of way. The liberality of this expenditure is indicated by a comparison with that of 52 other leading roads for the past 10 years. During this period these roads spent an average of 13.3 per cent of their gross revenues for this purpose as compared with 15.5 per cent for the Santa Fe. Making another comparison, the average annual expenditure per mile of line on the Santa Fe for the last five years has been $1,589, while on the Burlington it has been $1,458, and on the Southern Pacific $1,529, these latter two roads being recognized as unusually well maintained and as fairly comparable in climatic and other conditions. The activity with which this policy has been followed since the first year of control is shown by a statement in the third annual report for the fiscal year ending June 30, 1898, that "nearly every building on the right of way between Chicago and El Paso, all buildings on the Southern California (those lines in southern California southwest of the connection with the Atlantic & Pacific-Southern Pacific line at Barstow), and a large number of buildings on the Gulf, Colorado & Santa Fe have been painted."

The standards of maintenance are high and a progressive policy has been followed in authorizing increased expenditures

to reduce ultimate maintenance charges as the following illustrations will show. At the present time all main and many branch lines are tie plated continuously, over 50,000,000 tie plates being in service. The Santa Fe has been a pioneer in the use of treated ties, having started treating them on an extensive scale at Las Vegas, N. Mex., in 1885. It now operates treating plants at Somerville, Tex., and Albuquerque, N. Mex., with a combined annual capacity of 3,600,000 ties or practically its entire annual requirements. Over 65 per cent. of all the ties now in the track are treated, and as result the tie requirements for replacement purposes are showing a marked decrease, amounting to over 600,000 ties for each of the past two years, while the average number of ties inserted per mile for the last five years shows a decrease of 9 per cent as compared with the preceding five years.

The Santa Fe has also been a pioneer in the use of screw spikes, installing the first section in 1905 and having over 120 miles of screw spike main track in service on January 1, 1912. Since that time their use has been extended gradually. On the Western lines it is now the standard practice to insert screw spikes in 8 ties per rail length when laying new 90-lb. rail to secure a more rigid track construction. Another interesting maintenance practice which has been followed, particularly on the Western and Coast lines, has been that of laying all curves up to 10 deg. to exact gage without any allowance for curvature, which practice has been found to result in a greatly reduced rail wear.

The Santa Fe has also been a pioneer in the use of ballasted deck bridges. Starting with this form of construction about 1898, over 160,000 lin. ft. of ballasted deck structures are now in service. This construction is general on the main lines, obtaining even on structures as large as the new bridge over the Missouri river at Sibley, Mo., with spans 396 ft. long, and it is being extended gradually to the more important branch lines. By this means, in addition to securing the other advantages of this form of bridge deck, the cost of maintenance is reduced at least one-half. These and numerous other expenditures are already paying excellent returns in the form of reductions in maintenance of way expenditures so that the relative comparisons are even more favorable to the Santa Fe than shown above.

MECHANICAL DEVELOPMENTS

At the time of the reorganization the road owned 962 locomotives while in 1904 this number had increased to 1,433 and at the present time it is 2,150. The number of passenger cars owned has increased from 641 in 1896, to 861 in 1904, and 1,653 in 1914, while the number of freight cars has risen from 27,719 in 1896, to 39,072 in 1904, and 69,366 in 1914. From this it will be seen that the increase in equipment has been particularly rapid during the last decade.

As would be expected, the increase in the weight and tractive power of the locomotives has been considerably greater than in the number of locomotives themselves, for a great deal of attention has been devoted to the development of heavy engines for use especially, on the mountain divisions, and this road has led in the development of certain types of engines. With widely differing conditions as regards grades on different portions of the system, the aim has been as far as possible to so adjust and distribute the motive power with reference to the grades as to require the minimum breaking up of trains at intermediate terminals. Thus, at present, trains are made up at Kansas City for delivery to the Coast lines at Belen and to the Gulf lines at Purcell without breakup, and it is expected that with the readjustment of motive power and of grades now contemplated between Kansas City and Chicago it will be possible within the next two or three years to despatch trains from Chicago to Belen and Purcell without changing tonnage. The average tractive power of locomotives has risen from 25,578 lb. in 1904 to 33,290 lb. in 1914, an increase of 30 per cent in 10 years. This compares with an average tractive power for the locomotives of the entire country for June 30, 1913 (the last figures available) of 29,702 lb. as reported by the Interstate Commerce Commission. West of Belen and Albuquerque the combined improvement in grades and motive power has increased the tonnage rating on the mountain divisions from 416 tons in 1897 to 1,300 tons today.

Because of the large proportion of the traffic which is time freight it has been necessary for the mechanical department to consider the question of speed as well as tonnage in designing the freight locomotives for use on many of the divisions, for it is necessary that they be capable of running at relatively high speed. One of the most successful recent types of locomotives placed in service on this line is the Prairie Mallet, which is hauling trains of 2,250 tons across the Belen cut-off at speeds up to 45 miles an hour.

The efficiency of the motive power and the economy of operation have also been greatly increased by the substitution of fuel oil for coal on all lines west of Winslow, Ariz. To insure a sufficient supply of oil the Santa Fe has acquired large areas of oil land in California which are operated by a subsidiary company. Considerable oil is also purchased from other producers for the purpose of conserving the road's own supply for future years.

Reference was made above to the liberal expenditures for maintenance of way. Those for the maintenance of equipment have been equally liberal. For the entire period under the present management these expenditures have averaged 14.5 per cent of the gross operating revenues, while for the past five years they have averaged 15.9 per cent, rising to 17.2 per cent in 1914. Combining the expenditure for the maintenance of equipment with that for the maintenance of way and structures, it will be seen that an average of 30.4 per cent of all of the gross revenues has been devoted to the upkeep of the property for the entire period the present management has been in control.

Two or three instances will be cited as indicative of the methods by which the equipment is maintained. To insure that the proper repairs will be made on each of the four grand divisions a car repair pool is maintained, and all charges for the system are distributed according to an arbitrary basis. In this way there is no incentive for one grand division to send bad order cars to another. Last fall floating car repair gangs were sent over the lines in the wheat belt of Kansas and Oklahoma to repair the surplus equipment stored along the road in order to insure that every car was in proper condition before loading. In the same way all refrigerator cars are thoroughly inspected and all necessary repairs made at the last terminal before distribution for loading. In this way not only is the equipment kept in good condition, but the damage claims have been materially reduced.

UNITED STATES NAVY SPECIFICATIONS.—The new specifications of the United States Navy indicate a changed opinion as to the extent to which sulphur is detrimental in steel castings. Former specifications allowed a maximum of 0.05 per cent sulphur in all carbon castings of grades A, B and C and 0.04 per cent in nickel-steel castings designated as "special grade." In the new specifications grades A and B are subdivided into two classes—A and D, the high carbon, and B and E, the medium carbon relatively. A and B maintain the old limit of 0.05 per cent sulphur and D and E permit castings to go as high as 0.07 per cent sulphur. The two subclasses include castings of less importance than the others. For castings in grade C the limit is changed from 0.05 per cent sulphur to 0.07 per cent. The nickel-steel or special grade castings now have 0.05 per cent instead of 0.04 per cent sulphur as the limit. The requirements for tensile strength are reduced from a minimum of 90,000 lb. per sq. in. in nickel-steel to 85,000 lb. The elastic-limit stipulation is 45 per cent of the tensile strength in carbon castings, instead of a definite limit in pounds. The elongation requirements are advanced from 20 to 22 per cent in the special, or nickel-steel, grade, and the bending bar required is 120 deg. instead of 90 deg.—*American Machinist.*

Locomotives Recently Built for Foreign Countries

Baldwin Works Completed Engines for France, Russia, East Africa and New Zealand in the Past Few Months

During the past few months, several notable orders for export have been filled by the Baldwin Locomotive Works. These are of special interest, not only because of the types of locomotives built, but because of the quick delivery effected. With comparatively little domestic work in hand, there were unusually good opportunities for the builders to concentrate on the foreign orders.

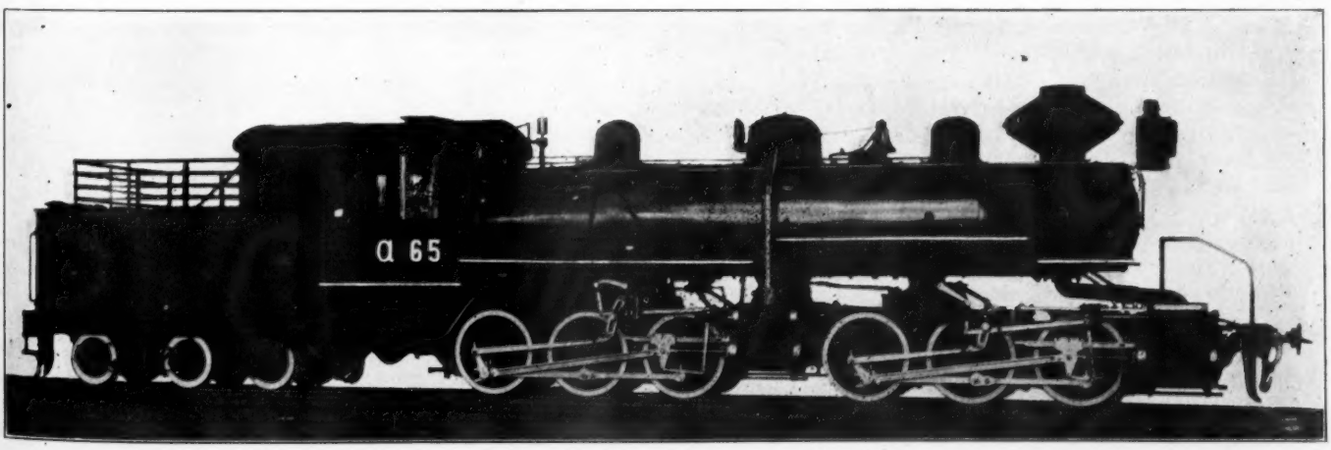
An order for ten Pacific type locomotives for the New Zealand government railways was received November 18, 1914, and the last engine was completed January 7, 1915. These locomotives are suitable for either passenger or freight service; the weight limit specified was 12 tons (of 2,240 lb.) per axle, or 1½ tons per foot of total length. With these limitations, and a track gage of 3 ft. 6 in., a most effective design of locomotive has been produced. The tractive effort exerted is 22,900 lb., which is unusually high in proportion to the weight on the driving wheels, which is 76,000 lb. The driving wheels are 49 in. in diameter, the cylinders 18 in. by 24 in., and the working steam pressure 170 lb.

In construction, these locomotives follow American practice closely. The boiler is of the straight top type, with a wide firebox, a Schmidt superheater and Security sectional arch. The steam distribution is controlled by 9½ in. piston valves, which are driven by Walschaert motion. The cylinders are cast separate from the saddle, and live steam is received through outside steam pipes. Other features of interest include the Hodges design of trailing truck, English Westinghouse brakes, and acetylene headlight and cab lights. The tender is carried on two four-wheel trucks. All the wheels under the locomotive and tender have cast steel centers, and are steel tired.

The 2-10-2 type locomotive illustrated is one of two built for the Lourenco Marques Railway, in Portuguese East Africa. This engine is of rather unusual size and capacity for a gage of 3 ft. 6 in., as it develops a tractive effort of 33,400 lb., with a ratio of adhesion of 4.3. The line is laid with 80-lb. rails, and has curves of 300 meters (984 ft.) radius and maximum grades of 1½ per cent. Under these circumstances, the use of a locomotive having a long rigid wheelbase is not prohibitive. Flange oilers are applied to the first pair of driving wheels, and the wheels of the third pair have plain tires.

2-10-2 Type Locomotive for Portuguese East Africa

These locomotives, apart from their dimensions, are similar in design to the 2-10-2 type locomotives operated in the United States. The special equipment includes a Baldwin steam brake on the driving wheels, and the English automatic vacuum brake on the tender, with train connections. A boiler feed pump is applied, and is driven from the right hand crosshead. The boiler is of the straight top, wide firebox type, equipped with Schmidt superheater and Security sectional arch. The weight on drivers is 144,000 lb., while the total engine weight is 179,100 lb. The cylinders are 21½ in. by 24 in., the driving wheels 48



Wood-Burning Mallet Compound for the Archangel Railway, Russia

in. in diameter and the working pressure 170 lb. The Mallet locomotive illustrated is one of 30 which were built for the Archangel section of the Russian government railways.

The order for these locomotives was received November 10, 1914; the first engine was completed on December 21, and the last on January 6, 1915. The design was new throughout, and special care was necessary on account of the weight limitations imposed. The engines were built for a gage of 3 ft. 6 in., but the design is such that they can be subsequently changed to meter gage if desired.

The boiler is of the straight top type, with a long firebox placed above the frames. The inside box is of copper, and the tubes are of iron with copper ends. Wood fuel is used, and the grate consists of plain bars. The stack is of the Radley and Hunter type, with top and bottom sections of pressed steel, each made in one piece and formed in the same dies.

These locomotives use saturated steam, which is distributed to the high pressure cylinders by 8-in. piston valves and to the low pressure cylinders by balanced slide valves. The Walschaert motion is applied, and the gears are controlled by the Baldwin pneumatic screw reverse mechanism. The machinery is as light as possible, consistent with the required strength. Cast steel is used for the driving wheel centers, driving boxes, pistons, crossheads, and many of the structural parts. The weight on drivers, which is also the total weight, is 105,800 lb.; the cylinders are 13 in. and 18 in. by 22 in.; the driving wheels are 44 in. in diameter, and the boiler pressure is 180 lb.

The tender has a capacity of 2,640 gal. of water and 3½ cords of wood. It is carried on six wheels, the first axle being held in rigid pedestals, and the second and third in a truck of the arch bar pattern. The tender frame is composed of steel channels, and the tank is wedge shaped. The forward end of the tank is covered with a hood, and the locomotive cab is entered through side doors, the arrangement being such as to thoroughly protect the engine crew from cold and stormy weather.

Three orders for locomotives have been received from the French government, and have been filled with unusual despatch. The first order called for 20 tank locomotives of the 0-6-0 type. This order was received on Tuesday afternoon, November 3, 1914, and it was specified that the engines be finished at the earliest date possible. The first boiler was completed November 10, at 11 a. m.; and one of the locomotives was entirely finished on November 13. At 11:35 a. m., November 21, the last engine, completely boxed, left the erecting shop, the 20 locomotives having thus been completed in 16 working days.

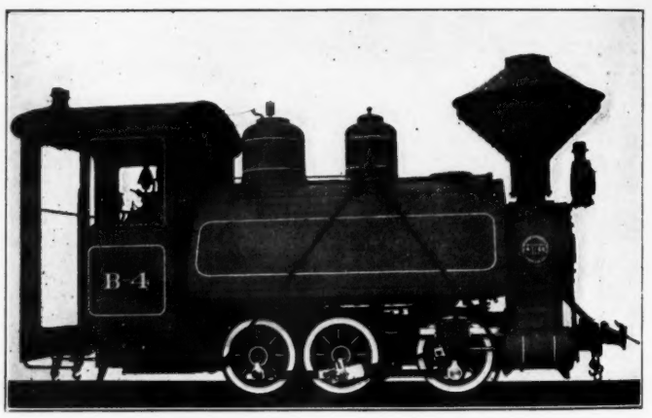
These locomotives have a track gage of 60 cm. (1 ft. 11⅝ in.), and are designed to traverse curves of 45 ft. radius and to operate on rails weighing 9½ kg. per meter (a little more than 15 lb. per yd.). They are equipped for burning wood, and have smoke stacks of the Radley and Hunter pattern. The water supply is carried in a saddle tank. The steam distribution is controlled by plain slide valves, driven by the Stephenson link motion. The cab is of steel, and both side windows and also the front window on the left side have drop sashes of steel, 3/16 in. thick. A steam brake, with auxiliary hand gear, is applied to the driving wheels. The weight of the engine is 29,000 lb., the cylinders being 9 in. by 12 in., while the driving wheels are 26 in. in diameter. These locomotives were each shipped complete in one case, ready to be fired up and operated immediately upon arrival at destination.

The second order from the French government called for six locomotives for service in Morocco. These are tank engines of the 4-6-0 type, built for the same gage as the 0-6-0 type locomotives previously referred to. They were designed to meet a limiting weight of four metric tons per axle. The water supply is carried in side tanks, and the fuel, which is soft coal, in a box back of the cab. The boiler is of the straight top type, with a copper firebox and brass tubes. The firebox rivets and water space stays are of copper. Walschaert valve motion is used, and the steam is distributed by plain slide valves.

Restricted space on these locomotives necessitates an unusual design of engine truck. Each side frame is cast in one piece with its adjacent boxes, and the castings are tied together at their ends by transverse tie rods. The transom is a steel casting which is pinned to the side frames, and supports a swing bolster through two links placed on the center line of the locomotive. The weight is transferred to the bolster through a coil spring, which serves the purpose of a center pin as well as providing the necessary elasticity. These locomotives were each shipped in one piece, completely assembled, except the stack and a few minor fittings.

The third order from the French government was for 100 locomotives of the Pechot type, with 0-4-4-0 wheel arrangement, somewhat similar to the well-known Fairlie type. Fairlie locomotives have been used in this country to only a very limited extent, attempts to introduce them having proved unsuccessful. Their use abroad has been confined to roads where curves are frequent and sharp, necessitating locomotives of unusual flexibility. The Fairlie type differs from the Mallet type in that it is carried on two steam trucks or "bogies," and is provided with a boiler having two barrels, or cylindrical sections, and two fireboxes. The latter are placed in a single outside shell, which is located between the bogies. This provides an exceedingly flexible locomotive, but introduces certain complicated features which have always been considered undesirable in American practice.

The locomotives now referred to have a gage of 1 ft. 11⅝ in. They were built throughout to metric measurements, and



Six Wheel Tank Locomotive for the French Government

represent a design introduced in 1888, and which has several times been duplicated since that date. Although these locomotives are very small, they are of unusual interest in view of the many special features incorporated in their construction.

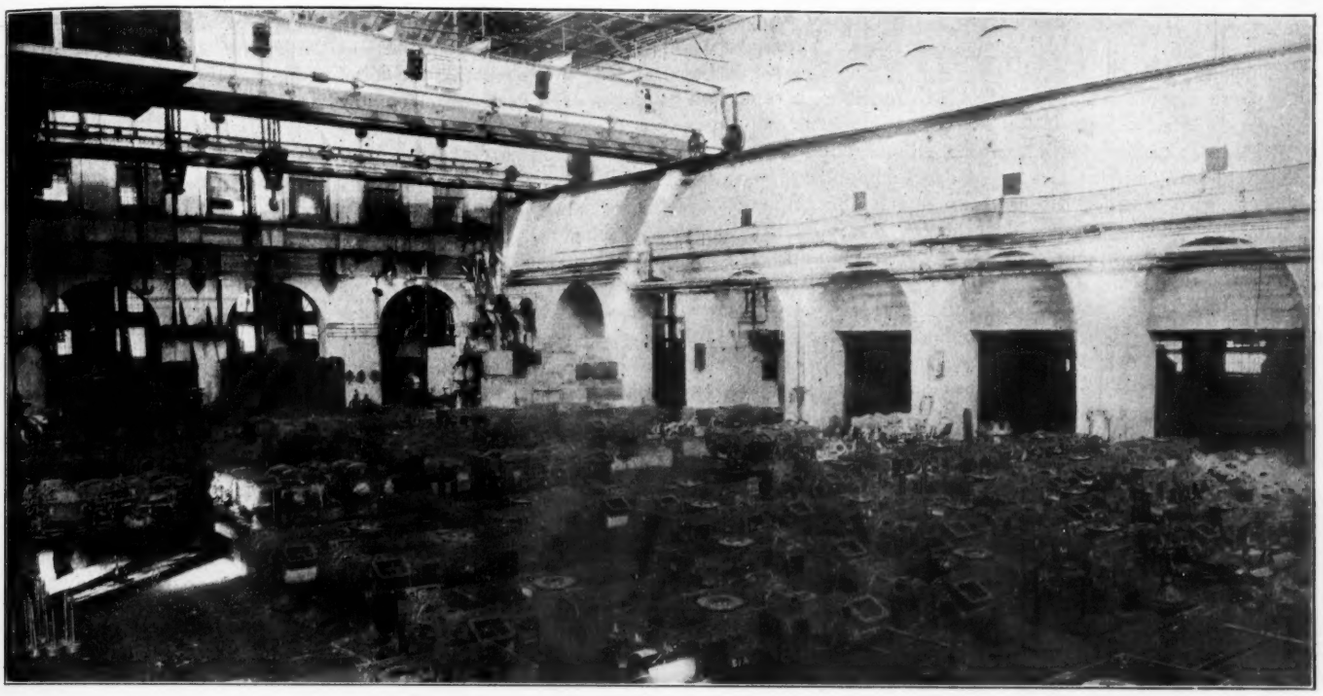
The boiler has a steel shell, with copper fireboxes and brass tubes. The fireboxes are separated by a water space 50 mm. (about 2 in.) wide. Each communicates with a separate set of tubes, and there is a smokebox and stack at each end of the boiler. A high steam dome is placed above the fireboxes. The boiler barrels are supported on saddles placed above the bogie center pins, and the firebox is supported in a cradle, consisting of two plate frames which are riveted to the saddles. The boiler shell rests on the saddles, but is not fastened to them in any way. This construction supports the boiler firmly, permits expansion and contraction of the shell, and also maintains the correct distance between the bogie centers.

The bogie frames are of steel plate, placed outside the wheels, while the driving boxes are of wrought iron, case hardened and tempered. The wheel loads of each bogie are equalized. The steam distribution to all the cylinders is controlled by balanced slide valves which are circular in plan, and are driven by Walschaert motion. The four gears are controlled simultaneously by means of a hand lever. An interesting detail is the arrangement of the live steam pipes, which leave the boiler through

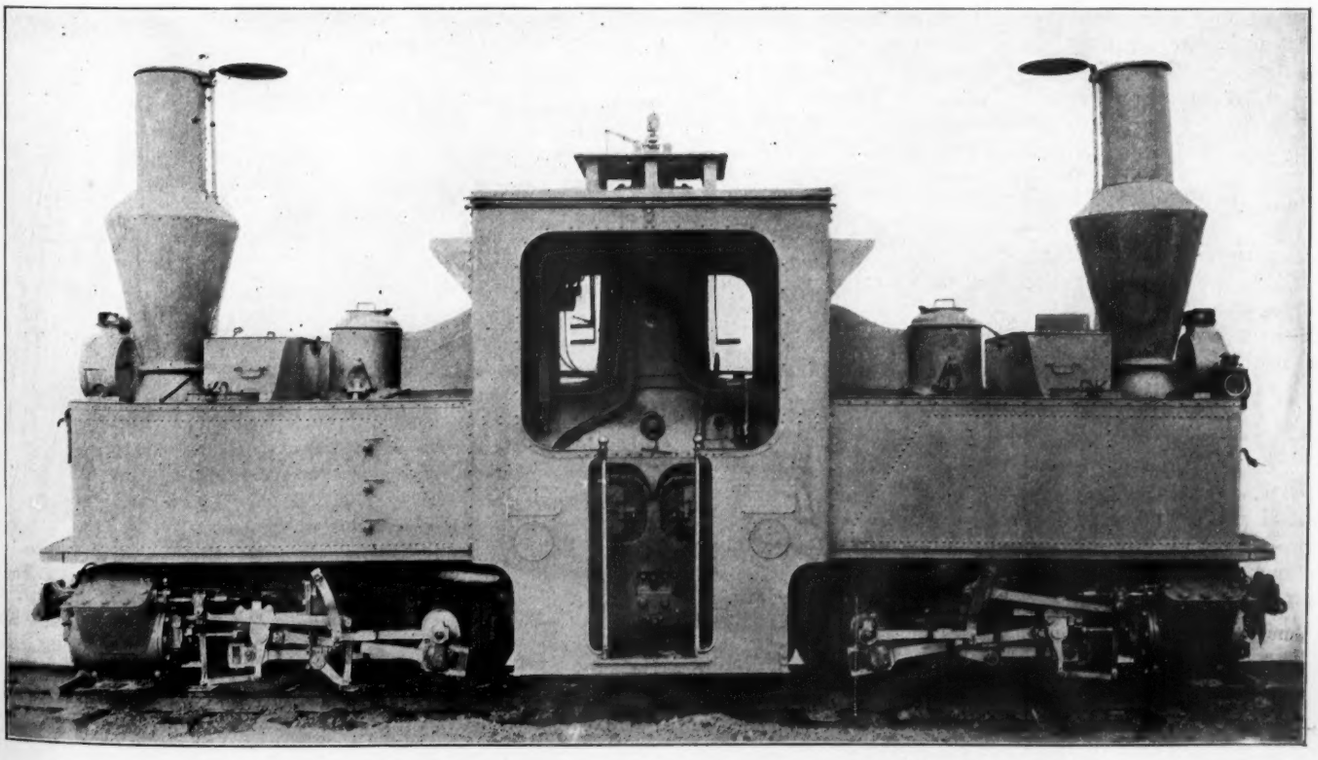
openings in the bottom and pass down through the bogie center pins. The ball joint in the pipe can thus be arranged to coincide with the center on which the bogie swivels. Each pair of cylinders is located under its respective smokebox, so that a comparatively simple arrangement of exhaust piping can be used. The exhaust pipe has a ball joint at its lower end.

The locomotives weigh, in working order, 12,790 kg., or 28,100 lb. The cylinders are 175 mm. by 240 mm., or 6.88 in. by 9.44 in., and the driving wheel diameter is 650 mm., or 25.5 in.

The water supply is carried in four side tanks, one of which is placed on each side of the two boiler barrels. All four tanks are connected by equalizing pipes. The cab is located between the tanks, in the center of the locomotive. The two tanks on the fireman's side are shorter than the others, thus providing space adjacent to the cab for coal bunkers. Each firebox has a side door. Such an arrangement would be inconvenient on a heavy locomotive consuming large quantities of fuel, but on these small engines firing is a simple matter. However, it is



Running Gears of the Pechot Type Locomotives in the Philadelphia Erecting Shop; They Were Shipped to the Eddystone Plant in Automobile Trucks



Fireman's Side of One of the Pechot Type Locomotives Built for the French Government

necessary to have two operators, as the boiler runs through the cab and it is impossible to step from one side to the other.

The locomotives are equipped with a hand screw brake, which can be applied from either side of the cab. The brake shoes are of poplar. The drawbars are of the radial type rotating about pins whose centers are located as close as possible to the bogie centers. These pins are seated in transverse steel castings, which are riveted to the side frames.

The steam dome contains two sliding throttles, each connected to a pipe leading to one of the bogies. In the cab are three throttle levers; two of these operate both throttles and are so located that one of them can be easily reached from any part of the cab. The third throttle lever controls the admission of steam to the cylinders of one bogie only. Normally this lever is latched with the others, so that all four cylinders receive steam simultaneously. If it is desired to run the engine with one-half of its power, the third throttle lever can be unlatched and steam used in only one pair of cylinders.

Special provision has been made to insure easy riding qualities. The weight is transferred to the bogie center pins through heavy rubber washers, which absorb vibration. The bogie side bearings are also of rubber. The bogie frames are connected to the frames supporting the boiler by links fitted with specially designed springs. These act as a centering device, and aid in restoring the alinement of the bogies after traversing curves.

The American-made equipment used in these engines includes injectors, whistle, safety valves, lubricator, steam gages, headlights, and cab and signal lamps. The steam gages are graduated to indicate the pressure in kilograms per square centimeter.

These locomotives were built to exceedingly rigid specifications, which covered not only the quality of the materials, but also the methods of manufacturing the various details and of erecting and testing. It was specified that each locomotive should be run under its own steam for approximately half a day. The engines were erected at the Eddystone plant, and a special track was built for testing purposes. During part of its run, each locomotive was required to draw a train of four small cars, which were loaded to a total weight of 30 tons. The locomotives rode admirably; there was practically no jar or vibration in the cab and very little lurching when traversing curves and passing over uneven track.

The engines were each shipped complete in one case. The stacks and a few small fittings were removed, but were boxed with the locomotive; so that very little erecting work was necessary on arrival at destination. Considering the unusual design and the rigid specifications, these locomotives were built in a remarkably short space of time. The order was received on February 1, 1915; 40 engines were shipped on March 31, and the last one left the works on April 24.

Germany's Strategic Railways.—Although a multitude of writers have enormously exaggerated the extent of the network of strategic railways in the German Empire, it is a fact that no other country has built anything like such a large railway mileage mainly or entirely with a view to its utilization for offensive purposes. If any country is in the future allowed to build such railways unchecked, it will represent a constant menace to the peace of the world. It is true that Germany's defeat will mean that a large proportion of these strategic railways will pass into other hands, the unification of Poland and the restoration of Alsace-Lorraine to France, meaning, incidentally, the loss to the German Empire of strategic railways. But these territorial changes will not in themselves prevent Germany from laying down a network of strategic railways to convenient points on the new frontiers. If the allies are determined to smash Prussian militarism, they will have to take account of this matter, as well as of armaments and the like. Alone among the great powers, Germany has for years past built railways with the definite and deliberate purpose of aggression. It should be the task of the allies to see to it that the terms of peace contain provisos that will at least check this kind of preparation for war in the near future.—*Railway Gazette.*

MISSOURI, KANSAS & TEXAS

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Can you tell me, who, or what, is to blame for the low price of M. K. & T. stock? I am the owner of some of it, and that is why I inquire. Considering all things, of course, it should be low priced now, in common with all other railroad shares, but it does seem to me this stock is unreasonably and unrighteously low, under even present conditions. This company in the ten months of this fiscal year ending April 30, 1915, earned more in gross than in any other like ten months in its history, and nearly a million more than same period last year. It earned the largest net in its history in April, 1915, and the largest net in ten months in its history. Also it earned in that period the largest surplus in its history and the dividend on its preferred stock more than three times over. It has paid its dividend on preferred stock for more than ten successive years, except last year, and has earned an average, at least, of 1½ per cent on its common stock for more than ten successive years, but has paid its common stockholders nothing. It will, at the end of fiscal year ending June 30, 1915, at present operations, have earned more gross and more surplus than any like period of its history. The territory served by the road has grown more rapidly in wealth and population in the past three years than any territory of like extent in this country and every factor that makes for growth, development and wealth is at the present time wonderfully promising. Have gross, net and surplus earnings, and rapid development, nothing to do with values? Compare this road with others of like, or even greater mileage, and M. K. & T. loses nothing by the comparison. If all the above do not create "a marketable and mortgageable equity," what does constitute such things? With all these rugged facts will the "Board" dare to pass the dividend on the preferred stock this year?—C. C. B.

Answer.—This year the earnings of the M. K. & T. have nothing to do with the market price of its shares. M. K. & T. stocks have been low, because of the road's financial position. On May 1, $19,000,000 5 per cent notes fell due, and as no satisfactory arrangements could be made with bankers as to paying them off, holders were asked to consent to an extension of the notes for a year. Interest rate on the notes was increased to 6 per cent. Approximately 95 per cent of the note holders agreed to the extension, leaving about $1,000,000 of the notes still undeposited. Last week, a holder of $10,000 of the notes secured an attachment in the New York Supreme Court against the road for the amount of his holdings. In the meantime, a special committee of directors is working on a financial readjustment plan, which has for its primary object the paying off of the notes, or their permanent funding. This plan has been somewhat delayed by the international situation, but the management hopes to have it completed, and underwritten in the not distant future. Naturally, if such a plan can be underwritten, the company's serious difficulties are at an end, for with the notes paid off or otherwise taken care of, the question of pressing financial obligations would be disposed of satisfactorily. The above situation as outlined explains the weakness of the stock.

To date there has been no acute danger that a reorganization of the road would be sought through the courts. For the fiscal year ending June 30, M. K. & T.'s surplus after charges will be $1,500,000, but there is no question of paying any dividend on the preferred stock. All surplus will be put back into property improvements, or used to clear from the books some of the temporary loans. It is understood that the road has short time bank loans of about $2,000,000. The company officials regard the present traffic outlook as very satisfactory.

Water in Coal Mines.—For every ton of coal raised from one of the anthracite mines, the operators of that field are obliged to pump to the surface about 11 tons of water. It is estimated that in the anthracite mines there are 900 pumps in use at the present time. The capacity of these pumps is approximately 1,000,000 gal. a minute.—*American Machinist.*

The Ticket Offices of Large Passenger Terminals

Factors of Design and Operation Influencing the Efficiency of the Ticket Offices in Such Stations

The ticket office is usually the first place where the passenger comes in contact with the railway, through its representative, the ticket clerk. A passenger's opinion of the line on which he travels is formed very largely by his treatment by the railroad employees. Since first impressions count most it is easy to see wherein lies the real work of the ticket office. It must sell tickets, but it must also do its part to encourage good will towards the railroads. To be efficient the ticket office must be such that its clerks can work in pleasant surroundings under pleasant conditions, for these are conducive to courtesy and careful performance of duty.

The function of selling tickets is so important that the location, layout and organization of the ticket office should receive most careful attention. The existence of so many stations, some of them new ones, in which the ticket offices have been entirely subordinated to architectural exigencies shows that this problem has not always received deserved attention. Every effort should be made, therefore, to ascertain what has already proved best. Presumably those best informed are the ticket agent and his assistants. They know how the traffic runs, they know its peculiarities and they alone know how well or ill their office does its work. The agent usually has some practical ideas of improvement, and whenever he proposes or disapproves his argument should be given weight accordingly. It is often worth while to call on other agents at stations in the same city. Every city has its peculiar idiosyncrasies and other offices may have some good ways of meeting them. Designers often seem reticent to call on the experience of other cities; the idea deserves greater consideration. It is not advisable to introduce new departures in design without careful study. One of the greatest faults in modern passenger terminal design is this striving for the original or the spectacular. The most successful features of proper ticket office or terminal design are the well established ones.

LOCATION

The ticket office should be so placed relatively to the station's other facilities that a person entering the station may buy his ticket, check his baggage and proceed to his train without retracing steps. The office should, if possible, be in plain view. Usually, if it is well placed no signs are necessary to indicate where it is. If it is not so placed there should be signs to make up for the delinquency. Whether the ticket office be in the waiting room, on the concourse or in a special so-called ticket lobby depends entirely on the station. Preferably there should be a ticket lobby through which passengers who have to buy tickets may proceed without molesting persons in the waiting room. If the waiting room is that part of the station around which all the other facilities center, the ticket office, being the most important, should be among them. At stations where there is a large proportion of suburban traffic it is not advisable to make the waiting room a general entrance or passageway. The commuters should preferably enter the concourse directly from the street, and the ticket office and the other station facilities should face or lead from the concourse. This makes the concourse the passageway it is intended to be and leaves the waiting room a place to wait and rest. The tendency of passengers after buying their tickets is to move towards the platform gates. To avoid congestion about the ticket windows, the office should be across the waiting room or concourse from the train shed.

A SINGLE TICKET OFFICE PREFERABLE

It is usually inadvisable to have more than one set of ticket windows. There are some stations used by two or three roads in which each line prefers to have its own ticket office, but unless each office does sufficient business to make it an economic unit, it is usually better to confine the work to one office. The organization is more flexible, and since there is no duplication the work can usually be done by fewer clerks. Patrons find two or more offices an inconvenience, because they are continually going to the wrong window. There is also better opportunity for supervision if the work is confined to one office. In many stations, however, there are special physical conditions which make necessary a division of ticket office facilities, as for example at the Grand Central or the Pennsylvania terminals in New York, where there are two separate levels.

It is impossible to define any rules relative to the size of a ticket office. A passenger station usually lasts at least 20 years. The ticket agent's domain should be designed with that in view, or so laid out that it can be enlarged without unnecessary rearrangement of other facilities or reconstruction of the station. There is absolutely no justification for cramped quarters for the ticket selling force in any new large passenger terminal.

LET THERE BE LIGHT

It is to some extent unfortunate that ticket office designers do not more often consider how easy it is to secure outside light. The problem in many cases is not so much to place the office where it can get natural light but to see that outside light is not shut off. If the office is in a large light waiting room, for example, the proper thing is to get all the light possible from the big area. Instead of placing a solid roof over the office and shutting off the light from the top it would be better to use a grating or a glass roof which can be opened if necessary for ventilation. In the same way, care should be taken to have windows or skylights wherever possible, and, if there are such already, not to block them. The natural light is free; it is far better for the eyes and if there is plenty of it the open and bright effect will have a most salutary effect on the clerks and their relations towards the public. Precisely the same considerations apply to ventilation. A poorly ventilated ticket office is as stuffy as a prison cell and not the least conducive to courtesy and accurate work. Care must be taken, on the other hand, not to have a draughty office; illness will not promote courtesy.

COUNTER ARRANGEMENT

The height of the counter is quite important, especially in a busy office, because if the counter is a few inches too high it hinders rapid work, and if too low the clerk may acquire a stoop. Careful tests have shown that about 3 ft. 8 in. is the best height.

The size of the counter deserves considerable attention. Its width should be sufficient on the inside so that the clerk can easily place the ticket and money on the counter, but not so wide that he has to reach unnecessarily to push them out to the purchaser. It is usually not best to use the inside counter as a desk for writing coupon tickets; it is better to use a special desk set to one side of the window or a few feet in the rear of it for this purpose. This desk is usually like a short bookkeeper's desk. It is the right height for writing; and the clerk while fixing a long coupon ticket can have all the room he wants without being bothered by well intended, but unnecessary remarks about the weather and business.

The tendency is to make the counter too wide on the outside of the grill. The shelf should be wide enough so that the passenger can easily open his pocketbook on it. It should not be so wide that he must lean over it to make himself heard, or to tempt him to put his baggage on it.

The front of the office, outside, is not complete without a baggage shelf about knee high below the counters. Passengers find it a great convenience to rest their bags on this shelf and since the bags are nearer than if they were on the floor feel

more at ease. The shelf should be about 8 or 10 in. wide. It is usually made of some material, such for example as ornamental brass pipe, which harmonizes with the surroundings.

Ticket counters in modern ticket offices are not often of wood. Much better results are obtained by using glass, marble or a similar material. Wood is not fireproof and it has a tendency to absorb moisture on damp days whereupon the difficulty of sliding tickets over it is liable to wear on the seller's nerves. But the worst thing about a wooden counter is that it is so nearly the same color as the money passed over it, that the passengers are much more likely to leave change on it than on glass or marble. The counter should be of a material which does not reflect too much light. Marble is very satisfactory, bright brass or similar material impossible. Thick plate glass firmly imbedded and painted black on the under side or placed on a dark green mat is also satisfactory. The counter should not be so thick that passengers can not take their change without fear of dropping some of it.

If the ideal ticket office were in an ideal community its windows would have no grills. The average ticket buyer goes to a ticket office so seldom that he is easily inconvenienced by having to talk through a grill. Nevertheless it is necessary to protect the tickets and money. Without it the latter would have to be moved so far back from the counter as to interfere with rapid selling. The grill used in railway ticket offices is preferable to the glass front of the average theater ticket office. It should be of simple design and constructed of vertical rods with a dull finish. A grill of complicated design collects dust, is hard to clean and almost serves as a barrier between clerk and patron. One of bright finish reflects too much light.

It has been stated above that the properly located ticket office needs no signs to indicate its position. It is always necessary, however, to have a sign over the office to indicate that it is the ticket office and usually a sign is needed over each window to indicate the kind of tickets sold at that window. The system used at the Grand Central Terminal deserves mention. Over each window is a lighting fixture with a triangular globe on which is painted the word Through, Local or Pullman. There is a light in the globe only when the window is open, and the passenger can see at a glance to what window he must go to get his ticket.

OFFICE EQUIPMENT

Ticket office equipment has become so well standardized that but little need be said concerning it. Although some recent installations of wooden equipment have been made, present tendencies are towards the use of steel cases almost exclusively. Steel is slightly more expensive than wood, but it has advantages that make it peculiarly adapted for ticket offices. It is fireproof, and there are few places where that quality is more valuable than in a ticket office. Tickets are more than "scraps of paper," and if a station's stock of them is destroyed it is a tremendous task, as well as a costly one, to replace them with sufficient quickness to prevent delay to business. Steel cases are more compact and a clerk working at a steel local ticket case has more of his tickets within arm's reach whereby he is saved many extra movements and can work at greater speed. There is also considerable saving in the stock room where the available space is almost always limited. It is well known that steel cases are cleaner than wooden cases and that vermin and rodents, even if they succeed in securing access to them, do not breed in them. The steel cases are less susceptible to weather variations, a considerable convenience in damp climates.

The ticket stock cases in many offices are adjacent to the selling cases. In some offices, however, the reserve stock is so great as to require a separate stock room. Usually the stock for a particular window, or, to be more exact, any particular stock, is kept compactly in a particular section of the storage cases. If a window is assigned and one clerk alone handles the tickets for it the clerk is given responsibility for the section of the cases containing his stock. He has a private key and only he and the ticket agent can have access to the tickets. It is even more essential that the ticket storage cases be fireproof than that the cases in the ticket office proper be so, and for that reason the use of steel cases is most advisable. The stock room should be in close proximity to the ticket office. In some stations the stock cases are on a mezzanine floor in the ticket office. The idea is good from some points of view, but the office is often given a crowded effect and the outside light is sometimes cut off considerably.

The desks for the cashier and the accountants are usually in or near the stock room, for therein is usually the most available space. The idea is good provided the room is light and well ventilated, because it helps to keep the various departments of the office compact. The ticket agent's desk is usually in a convenient nook in the ticket office proper, although in some stations the agent is considered important enough to have an office of his own. In the latter case the agent and his assistants will be saved many steps if this office is adjacent to the ticket office, the stock room and the accounting desks. If these facilities are separated private telephone connection between the various departments is necessary.

Every ticket office should be supplied with lockers in which the clerks may keep their wearing apparel. Steel lockers are to be preferred because they are fireproof. It is also advisable for the office to have its own toilets, as the latter will save many steps and considerable time.

SELLING TICKETS

Hardly two ticket offices have the same method of selling tickets. The chief difference is that in some stations a ticket for any destination may be obtained at any window, whereas in others there is a sharp distinction between local and interline business. Each system has its advantages and its advocates, but the determination of the method to be used at any particular station seems to rest entirely on the character of the traffic. For some reasons it would always be preferable to sell both local and interline tickets from any window. Passengers always have a tendency to go to the first open window they see and resent being sent from one window to another. Many of them either do not see the signs indicating whether the clerk has local or through tickets, or do not understand what the words mean if they do read them.

At many stations, however, it is impossible to sell both local and through tickets at the same window. Reference to conditions at the South station in Boston or the New York Central ticket office in the Grand Central Terminal in New York will explain. At either of these offices, and particularly at the former, a very large proportion of the tickets sold are card locals, while at the same time there is also a large percentage of interline tickets which must be handled in an entirely different way. The card local tickets are almost always purchased in haste; for the clerk to sell one requires but few seconds. The number of interline forms is so great, on the other hand, that the tickets cannot be within arm's reach; to obtain a through ticket, to write up a complicated one, in particular, and to sell it is frequently a matter of two or three minutes. It would check rapid work and try the patience of purchasers of local tickets if the locals were not sold at one window and the interline tickets at another. Except in cases like these, where there are peculiar conditions, it would seem advisable to sell both local and through tickets from one window.

It is next in order to treat of the methods of operation inside the office. As far as the traveler is concerned it would be preferable to have a separate stock of both local and interline tickets for each window. It has been seen that there are some cases where a separation of suburban business must be made. There are other offices where it is manifestly impossible, because of the great number of forms, to have the desired separate stocks of interline tickets. In the New Haven ticket office at the Grand Central Terminal, where there are 10 windows on the upper level selling both local and interline tickets, a through or suburban ticket may be obtained at any window. The interline tickets are, on the whole, comparatively simple and the

number of forms is not large. This is the best system provided conditions permit of its use, because a patron can get his ticket at any window, and because every ticket that may be called for is almost within arm's reach.

The Pennsylvania Railroad follows the same method at its New York terminal. The interline tickets sold at the latter are somewhat more complicated and the number of forms is greater, but the number of local tickets is not as large, since most of the suburban business is handled at the Long Island ticket office on the lower level. The ticket office of the Boston & Albany at Worcester, Mass., sells local and through tickets over three roads. There are five ticket windows and the number of interline ticket forms is so great that the interline ticket case extends the full length of the office. There is a separate stock of local tickets for each window. For each window also there is a supply of the most lively interline tickets, but there is only one stock of the other interline tickets for the entire office. This seems to be the best possible scheme for use at offices where there is a fair local business and where provision must be made for a large supply of interline forms.

At the South station in Boston, there is an absolute division of through and local business. Each local window has a separate stock of local tickets and a supply of some of the more important interline tickets. There is but one stock of the ordinary interline forms for the several windows selling through tickets, but at each through window there is also a supply of some of the livelier long-distance local forms.

It is usual in ticket offices having a sufficient number of windows for the purpose to assign each window to a particular clerk and to permit him and the ticket agent only to have access to his cases. The clerk is thereby given an undivided responsibility for the appearance of his ticket cases and for his tickets, as well as for his cash. The window can only be used when he is on duty and his account for both tickets and cash is entirely distinct from that of any other clerk. Of course if three or four clerks are selling from a single interline ticket case the idea must be modified to suit; in principle, however, it remains the same. In this scheme no tour system is necessary. The clerk going off duty simply closes his window and can check cash and tickets without unnecessary haste and without interference by the clerk who, with a tour system, would follow him at the same window. The clerk coming on duty finds things just as he left them the night before and knows exactly where he stands without having to see that the clerk on duty before him has left matters just as they should be. It is another advantage that if one clerk is to relieve another there is absolutely no delay. It is a disadvantage that there must be a separate stock of tickets for each window, but in most offices a separate stock of local tickets must be supplied for each window anyway. In a busy office, in addition, it should be no hindrance, for the turnover of tickets will be sufficiently rapid for them to be sold before they have become too old. It would seem as though the advantages of assigning windows in a station busy enough to warrant that procedure outweighed to some extent the disadvantages.

Windows cannot be assigned according to the above method unless there is a sufficient number of them or unless a few cages that can be moved on rollers are used. The latter are so bulky and require so much extra room when they are not in use that they do not often meet with favor.

PULLMAN TICKETS

If, in the city served, the railroad maintains a number of city ticket offices, it is a problem to take care of the Pullman reservations. It is usual either for each office to be assigned a certain portion of the chairs and berths, or for one of the offices to be given entire charge, reservations at the other offices being made only on its authority as given by telephone conversation. For obvious reasons the office handling the reservations must be connected with all the rest by private wires. In many cases it has been found best for the one of the city offices to handle reservations. The entire list is kept at that office, entries being made to suit the reservations, until about one-half hour before train time, when the diagrams are sent to the ticket office at the terminal, sales being made there until a few minutes before the train leaves, when the statement is sent out to the train. In some cases the reservations are telephoned to the station office and there are a few instances in which they are telegraphed.

One solution of the problem that deserves more than passing mention is that worked out at one of the terminals in New York City. The ticket office is a large one. There are often four clerks selling Pullman tickets, and in addition it handles reservations for all the city offices. Behind the clerks at the windows is a large rack, holding all the cards for several days ahead. The rack is so arranged that cards may be taken from either side of it. On the opposite side is a table at which sit the clerks who handle the reservations asked for by telephone, the rack being so devised that the clerks on one side of it can obtain the diagrams without interfering in any way with those on the other side.

It is impossible here to treat of the methods of accounting which form an important part of the work of the ticket office.

"COURTESY ALWAYS"

It has been stated that each clerk should be provided with a locker. He should also be assigned a private drawer or compartment for his money in the office safe. Each of these compartments should have an individual lock, a combination perhaps being preferable, and the clerk, himself, and possibly the ticket agent in charge of the office should be the only ones to have access to the contents.

If ever the safety-first movement is succeeded or supplemented by a campaign of "Courtesy—Always," as is beginning to seem possible, ticket agents in charge of terminal ticket offices will have first claim to appointments as "Courtesy-Always" agents. The ticket agent has peculiar qualifications for the job. He knows how to pick men, how to train them in ways of courtesy towards the public, how to supervise them in the results of their training, and presumably he has been through the mill himself. It is possibly somewhat strange to speak almost as though courtesy were the first requirement for proper ticket selling. Courtesy is not the first requirement; it is subordinate to honesty and perhaps to accuracy, but it is the thing that needs most emphasis.

The ticket agent at the large station is usually given entire responsibility for the proper conduct of the work of his office, subject to the approval of the station master or some similar officer. He is, therefore, allowed to choose his own men. Each agent has his own ideas as to the best methods of picking assistants. Some find it best to take men from smaller stations on the line, and others to take them from other service in the terminal, as for example, from the information bureau. In almost every case an effort is made to secure men who have had service with the company. Such men already have a fair knowledge of the road's passenger service and are usually well versed concerning fares and connections. They only need to learn how to sell tickets under the arduous conditions of busy terminal ticket office service. It is now considered bad practice to take men from ticket offices of other roads, for it is the general opinion that positions in the ticket office should be looked upon as rewards for good work in other departments of the service.

The difficult task for the ticket agent is not to find men who are accurate and honest, but to find men who are sufficiently courteous. Courtesy, if it is not born in a man, can be acquired only by long training. It is hard to learn, because it is intangible and because it often seems as if to be courteous to some people were but a step to being servile; and to be servile hurts. The results of courtesy, so far as the ticket clerk is concerned are the impressions made on the minds of the purchaser. The ticket seller, therefore, must be something of a student of human nature. If he is fitted for his work, he should acquire a faculty of telling a person's character and frame of mind almost by his appearance, his actions and the sound of his voice. There are some people, however, who are tough nuts to crack.

The ticket clerk is paid to serve such people right. He will derive the most satisfaction from his work if he can take pride in solving the idiosyncrasies of people. He should feel that he has accomplished something when he has pleased a grouch, when he has convinced a crank that there is something intelligible about the timetables and tickets after all, or when he has conveyed a complicated bit of information to a foreigner who speaks almost no English. It has been suggested that he should put himself in the place of the person outside the window. The idea is a good one. Every person who asks a question usually has good reasons for the query, and if the clerk will think a moment he can usually frame an intelligent answer no matter how foolish the question. There are few snobs in this world, but there are enough and they are the hardest kind of people with whom the ticket clerk has to deal. He should, nevertheless, try to follow his rule of putting himself in their places. When they have gone he can find solace for any ill-treatment in thanking Heaven that the state is figurative, not normal.

It is usual in most large offices for the junior clerk to be put on local tickets first and then for him to work up gradually to one of the windows selling complicated interline forms. In one large office each clerk is strongly encouraged to understudy the next higher man. Each clerk is thus always improving himself for his next higher position, and if the older clerk is out his place is easily filled. Schedules and rates are changed so often that even an experienced clerk must learn new things about his work continually. The ticket agent can never be too careful that the orders and instructions are properly understood and remembered. At the office mentioned above the agent has a check on this in the form of periodical written tests. It is something of a job to compile the various questions, and even more difficult to correct the papers, but the office always knows where it stands. The agent is sure that orders are being understood and he has a check on every man. The same agent also holds monthly or bi-monthly staff meetings. Here he has a chance to emphasize the need of courtesy and every man has an opportunity to offer and discuss all kinds of suggestions for the good of the office. It is a waste of words to say that the staff of this office and its management are unexcelled.

TRAIN ACCIDENTS IN MAY[1]

The following is a list of the most notable train accidents that occurred on railways of the United States in the month of May, 1915:

Collisions

Date.	Road.	Place.	Kind of Accident.	Kind of train.	Kil'd.	Inj'd.
5.	St. Louis, I. M. & S.	Grassy Lake.	bc	P. & F.	1	29
15.	N. Y. Central	Scarborough.	rc	F. & P.	0	6

Derailments

Date.	Road.	Place.	Cause of Derailm't.	Kind of train.	Kil'd.	Inj'd.
3.	Norfolk & W.	Boyce.	unx	F.	1	3
3.	Southern	Marion.	d. track	P.	0	3
14.	Balt. & Ohio	Belmont.	d. drawbar	F.	8	0
15.	Chicago, M. & St. P.	Yankton.	b. flange	P.	0	20
15.	Southern	Toccoa.	unx	F.	0	0
*17.	Missouri Pac.	Nebraska City.	b. wheel	F.	5	0
22.	Northern Pac.	Honeyford.	unx	P.	0	20

The trains in collision near Grassy Lake, Ark., on the night of the fifth were eastbound passenger No. 20 and an engine without train, westbound. Twenty-eight passengers and five employees were slightly injured and a trespasser was killed. The light engine, in charge of a conductor, an engineman and a fireman, had encroached on the road right of the passenger train.

The trains in collision at Scarborough, N. Y., on the 15th were a northbound local passenger train and an electric locomotive without train, the locomotive running into the rear of the passenger train and damaging itself and the rear passenger car. Four passengers and two employees were injured. The electric engine had run past a distant and a home signal set against it.

The train derailed near Boyce, Va., on the third was a northbound freight and 21 cars left the rails. One trespasser was killed and 3 were injured. The cause of the derailment was not determined.

The train derailed near Marion, N. C., on the third was westbound passenger No. 1. One sleeping car was ditched and three passengers were injured. The derailment was due to distortion of the rails by excessive heat, at a place where new ties were being put in.

The train derailed at Belmont, Ohio, on the 14th was a westbound freight, and 14 steel cars were wrecked. Riding on the cars were a number of trespassers, of whom eight are said to have been killed. The derailment was due to the failure of a drawbar which was pulled out and fell to the roadbed.

The train derailed near Yankton, S. D., on the 15th was an eastbound passenger and the three rear cars were overturned. Eighteen passengers and two trainmen were injured, none seriously. The cause of the derailment was the breaking of the flange of a wheel of a freight car.

On the Southern Railway near Toccoa, Ga., on the 15th there was a derailment in which several freight cars were wrecked which ordinarily would not appear in this list, but which became prominent by reason of the fact that the next morning, while the wrecking crew were picking up the last car, six men, including the supervisor, the section foreman, and four laborers, were killed, and nine other employees were injured, by the fall of a car which was being lifted by derricks. A chain slipped and the car dropped suddenly on the men, who were beneath it.

The train derailed near Nebraska City, Neb., on the 17th was a westbound freight, and seventeen cars were wrecked. Oil or gasolene in one of ten tank cars took fire and the wreck was burnt up, including two carloads of silver bullion, the metal in which was melted. Five trespassers riding on the train were burned to death. The cause of the derailment was a broken wheel.

The train derailed near Honeyford, N. D., on the 22nd was southbound passenger No. 14. The train was running about 25 miles an hour. Eighteen passengers and two trainmen were slightly injured. The cause of the derailment was not determined.

[1]Abbreviations and marks used in Accident List:
rc, Rear collision——bc, Butting collision——xc, Other collisions——b, Broken——d, Defective——unf, Unforeseen obstruction——unx, Unexplained——derail, Open derailing switch——ms, Misplaced switch——acc. obst., Accidental obstruction——malice, Malicious obstruction of track, etc.——boiler, Explosion of locomotive on road——fire, Cars burned while running——P. or Pass., Passenger train——F. or Ft., Freight train (including empty engines, work trains, etc.)——Asterisk, Wreck wholly or partly destroyed by fire——Dagger, One or more passengers killed.

RULES FOR TRACK WALKING.—The first and most important rule is akin to an Irish bull: Don't walk on the track if you can possibly find any other road, path or field to walk on. But if you must walk on the track, then be sure to look behind you frequently, especially if the wind is blowing in the opposite direction as you are walking. On the approach of a train look around and let the engineer know that you see him. Don't wait until he is almost upon you, don't leave him in doubt. Don't compel him to whistle for you. Your danger grates on his nerves and the unnecessary whistling grates still more on the nerves of the peaceful dwellers along the tracks. If on a double track railroad, walk on the track on which trains come towards you, but don't neglect to look behind you often, for trains sometimes run on one track in both directions. . . . Never "hop" a moving car or engine; it is always dangerous; always gets your hands (and often your clothes) dirty, and very rarely brings a reward. Finally, the famous advice of Punch, about telling jokes applies with sledge hammer force to walking on tracks: DON'T.—*Alton (Ill.) Evening Telegraph.*

Necessity for Additional Revenues on Western Railways

Brief Submitted by C. C. Wright in Western Rate Advance Case Discusses Condition of Carriers Since 1901

The attorneys representing the western railways have filed their briefs with the Interstate Commerce Commission in the western freight rate advance case, and oral arguments are to be heard before the commission at Washington beginning on June 22. Separate briefs were filed by the committee of six attorneys representing all of the lines for the different commodities involved in the case. The brief on the necessity for additional freight revenues was prepared by C. C. Wright, general solicitor of the Chicago & North Western and chairman of the attorneys' committee. Some extracts from this brief are as follows:

The question naturally divides itself into three interrogatories, viz.:

(1) What is the revenue of the carriers and what return are they receiving upon their property?

(2) What is the cause of the low returns?

(3) What ought the carriers to earn?

REVENUES

We submit that the showing as to the 41 roads, which has been presented by the carriers, is the fairest way possible in which to determine the actual revenues of the roads in the territory, throughout which the advance in rates is proposed. It is true that there are some small lines which are omitted and that there has not been included in this group some which are known as transcontinental lines, and which will receive an incidental, small advantage by the advance. It is true, some of the lines extend into territory outside of that involved, but sub-groupings make it plain that the 41 roads reflect the condition in the territory.

Attention is particularly directed to the exhibit in relation to the net operating income of the various years. It is shown that the operating revenues for the period 1908-1914 increased $1,348.42 per mile of road, as compared with 1901-1907, but at the same time, the operating expenses, hire of equipment and joint facilities increased $1,407.34 per mile of operated road. The taxes in the second period, over those in the first, increased $115.17 a mile, while the rental and net lease of road decreased $20.95. As a result, the net operating income of these roads, on an average for the last seven years, has been $153.14 less than the average of the seven years immediately preceding. If the last six years are taken, as against the six years prior to that period, the results will not be materially different.

It will be noted that in only four of the years in the last seven, has the net operating income per mile operated, equaled the lowest net operating income during the prior period of seven years. In no year in the last seven has it equaled the highest yield in the prior seven years. The average for the second period was $2,045.34, as against $2,198.48 for the first.

It will be noted also that in 1909 and 1910 the return was much greater than in 1914. In three of the last seven years, the net operating income per mile has been less than $2,000, while it was less than $2,000 in only one year in the first period, which was the year 1904, when all business was paralyzed. If one compares the year 1913, one of large volume of business, with the year 1907, it is readily seen that the operating income per mile for 1907 was $260 in excess of that most prosperous year in the latter period.

If a comparison is made of the last five years, that is, 1910 to 1914, inclusive, with the five years immediately preceding, it will be seen the decrease is even greater than in the preceding seven-year period, so that any grouping of the years which may be selected indicates a declining net operating income per mile of road. Comparing the lowest year in the latter period with the lowest year in the first, shows a decline of $159.93. Comparing the highest year in the second period with the highest year in the first period, shows a decline of $285.63. A like comparison might be made by taking the two and three lowest in each period, or the two and three highest in each period.

The same story is told by Exhibit 10, in a comparison of ratios of operating expenses to revenue. In no year in the last period has the operating ratio been as low as in the former period.

The study of the variations of operating ratios, as made by the commission in connection with this case, is both interesting and illuminating. As stated in the resume presented by A. M. Bean, one of the examiners of the commission, it discloses that while exceptional conditions on individual roads may in part account for unusual variations in the operating ratio, there are certain general conditions which operate alike upon the different roads, which would have the tendency to increase the operating ratio. Among those are included the increase in wages; increase in price of fuel; increase in cost of ties; larger expenditures required to properly maintain road and equipment; increase in taxes; more numerous requirements by state and interstate commissions; decreasing revenue due to reductions in rates, and to the introduction of depreciation charges. These are all general in their character, and there is nothing in the record to indicate that there will be any change which would counteract such increased expenses. The only one of the general reasons why the operating ratio has increased which may be reasonably expected to be remedied is the one mentioned as the decreased revenue due to reduction in rates. That seems to be the only one in which this almost steady increase in operating ratio may be checked without serious detriment to the public service.

It would seem that these exhibits lead irresistibly to the conclusion that the net operating income per mile of road of the carriers is declining. It is shown that in 1914 it was only $1,963.36 per mile of road and that for the average of the last seven years it was only $2,045.34.

If the road and equipment cost, as shown in the exhibits and from the books of the carriers, represents the value of the property, it will be seen that the earnings for the last seven years yielded a net return of 4.19 per cent. In the year 1914, the earnings returned only 3.81 per cent. A comparison of different years in the same period demonstrates the decreasing rate of return, as well as the insufficiency of the revenues. The highest year in the first period was 1907, when it was 5.64 per cent, and the highest year in the second period was 1909, when the return was 4.61 per cent. During the first period, in no year did the return fall below 4.55 per cent. In only one year in the last period did it reach that figure; that is, there is only one year in the last period when the rate of return was as high as the lowest year in the first period. If comparison is made with the earnings in 1914 and the year immediately preceding, it will be seen that the returns had fallen from 4.44 to 3.81. The reports of the fiscal year 1915, so far as yet received, would indicate that 1915 was no better than 1914. The last five years of this period may be compared with any other five years that may be selected, but still the rate of return is less in the last five years. Even the panic year of 1904 was better than any year since 1909.

This showing of the carriers is not met by any counter evidence, because it cannot be. By grouping of strong roads protestants were able to show an earning above 6 per cent on the group selected, but they were not able to show a return of 7 per cent, even after making deductions from road and equipment of amounts which they had pointed out as, in their opinion improperly included, and without adding anything for working cap-

ital, during any of the periods. Even under the showing of selected groups by the protestants, the same downward trend was apparent.

THE CAUSES OF DECLINE

It is proper to discuss the causes of this declining net operating income from rail activities, and determine whether it is due to the fault of the carriers, or to causes beyond their control.

Attention is here directed to the fact that the carriers have been steadily investing more money in the property, amounting in the last seven years to more than a hundred million dollars a year for additions and betterments to the existing roads. They have been steadily improving the character of their railroads and equipment out of the money so expended. The evidence, we believe, fairly demonstrates that the roads in question in this case have been meeting the public demand and improving their service from year to year; they have increased their efficiency by all known means within their power. The density of traffic per mile has increased, and yet, notwithstanding all of these things, which make for efficiency and lower costs, the cost per unit of service has increased.

It is true that the operating revenues of the lines in question have increased, but it is also true that the operating expenses and the taxes have increased at a faster ratio. The revenues per mile of road increased in the last period over the first, on a yearly average of $1,348.42, but the operating expenses, exclusive of taxes, rental, etc., increased $1,407.34; the increase in taxes was $115.17 per mile and the decrease in rentals $20.95 per mile, which results in a net decrease on the average for the last seven years, as compared to the seven years prior thereto, of $153.14 per mile. It thus is apparent that the carriers have not been able by the means employed to meet the increasing costs out of increasing revenues.

It is difficult to determine accurately the extent to which each of the different causes has contributed to this result, but there are some things that can be pointed to as potent factors.

By exhibit 12 it will be seen that the ton-miles per mile of road had increased from an average of 613,059 tons in the first period, to 709,889 tons in the second period. It appears, however, that the increase in the first period was much more rapid than in the second. The average of the second period over the first was approximately 13.5 per cent. The average of the tons per train mile in the first period was 266.78, and in the second, 316.54, which was approximately 18.5 per cent. It will be noted, however, that the greatest increase was in the last period.

Notwithstanding the increased capacity and weight of the freight cars, it will be seen that the increase in the tons per mile, has been less than 10 per cent; and exhibit 14 shows that there has been very little increase in the revenue tons per car mile since 1907. This is partly accounted for by the fact of the low minimums which are enforced by various state commissions, and partly by the fact that with the diversified character of traffic and the necessity of special equipment, the empty car mileage has increased.

That the labor costs have been a material element in the increased expenses of the carriers is not only apparent from the special study of operating ratios, which was made by the commission, but appears conclusively from exhibit 15. This exhibit shows the increase in wages paid, year by year, on account of the increase in rate of pay. The exhibit was prepared to include general officers and also excluding general officers. It will be noted that the increase has been greater when the general officers are excluded than when they have been included. That is particularly noticeable in the last seven years. The increase in labor costs has not been uniform. From 1902 to 1903 there was a very large increase, being a little over six and one-half million. The increase for 1903 to 1904 was over four and one-half million. There was a material increase from 1907 to 1908, being nearly six million, but in 1909 there was a decrease of nearly two and one-half million over 1908. In 1910 the increase was over fourteen million, and in 1911 over twelve million. It will be noted that this increase came at about the time of the decision of the commission in 1910.

This exhibit shows that the increase in expenses, due to increase in the rate of pay for employees, was in the year 1914 over 1900, $85,167,085.95.

On exhibit 17 is shown the increase in taxes and the increase due to the advance in the rate of taxation. It shows that taxes in 1914 were $17,628,142.61 more than they would have been, if computed on the rate of taxation in 1901, or $179.06 per mile of road operated.

The increased labor costs, due to the increase in rate of pay, was $865.11 more per mile of road operated in 1914 than it would have been under the 1900 wage scale. This makes a total increased operating expense per mile of road operated, due to increases in the rate of pay for employees and the rate of taxation by states and municipalities of $1,044.17 per mile, which would be equivalent to a return of 2.02 per cent upon the cost of road and equipment. In other words, if the same wage scale and the same rate of taxation had been applied in 1914 as in 1900 and 1901, the carriers would have been able to have earned a return of 5.83 per cent upon the cost of road and equipment, instead of 3.81 per cent. This very definitely locates a large element of the increased cost.

Exhibit 18 shows in detail the increase in cost of material and other items. Attention is directed to the fact that since 1909 the cost per mile of road for material and other items has increased more than $400.

A study was made to determine as far as possible the relation of the maintenance costs. It was a recognized fact that maintenance costs, particularly of equipment, has increased in the last few years.

The ratio of maintenance of way and structures to the revenue has decreased in the last seven years over what it was in the preceding seven years and there is only a small increase in the ratio of maintenance of way and structures expenses to the cost of road and equipment. On the other hand, maintenance of equipment shows that it has increased faster than the revenue and faster than the cost of road and equipment. For the first period the total maintenance costs were 26.69 per cent of the revenue, and in the second period 29.24 per cent of the revenue. In the first period the maintenance expenses averaged 4½ per cent of the value of road and equipment, and in the second 5.29 per cent.

An examination of this exhibit, however, will disclose a rather uniform advance. It does not indicate an abrupt advance, due to change in accounting methods, in 1908. The increase, 1901 to 1907, in maintenance of equipment, amounted on these roads, to approximately $54,000,000. From 1908 to 1914 the increase was approximately $52,000,000. The gradual increase of this cost of maintenance of equipment would indicate that it was not due to the latter period to the depreciation account, but was the result of far-reaching causes.

Maintenance of equipment shows a much more radical increase. It will be observed, however, that maintenance of equipment per mile of road shows a steady advance. There was no sudden advance from 1907 to 1908. In 1906 maintenance of equipment per mile of all tracks operated was $809.22, in 1907 $894.01, in 1908 $849.08 and in 1909 $887.10.

NEEDS FOR THE FUTURE

In Wettling's Exhibit 29 the carriers assembled the amount of maturing obligations for the next seven years. This was for the purpose of indicating that the carriers involved in this case must renew a large amount of obligations or place new securities beyond the amount necessary for additions and betterments each year. It is true that the building of new roads in this territory has almost entirely ceased. It is not believed that the public is going to be satisfied unless additional lines are constructed. Every indication is that it will require as much for additions and betterments annually in the future as it has for the last seven years, therefore these various carriers must raise at least $100,000,000 a year from

some source, in addition to the amount necessary to refund or refinance their maturing obligations. For 1915 they would require over $155,000,000 for additions and betterments and to take care of maturing obligations.

A noticeable fact in this connection is that the increase in capital liability has been largely made by the increase of interest-bearing obligations, rather than by the increase of stock. Exhibit 28 shows that in 1910 the capital liabilities represented by stocks were 46.33 per cent, by bonds 53.77 per cent. In 1914 this had changed so that the ratio of stock to total capital liabilities was only 37.74 per cent and the ratio of bonds and funded debts had risen to 62.26 per cent.

The facts disclosed cannot help having an unfavorable effect on the borrowing ability of these carriers. We care not whether you call it credit, or not. They will not be able to borrow additional capital on as favorable terms as they would if their proportion of property represented by the bonds and outstanding interest-bearing securities was less. When we speak of the impaired credit of the railroads, we do not refer to the interest rate on underlying securities, which represent less than 50 per cent of the value of the property. What we mean, however, is that for new money and for money which is needed for additions and betterments and the development of the property, the carriers are not now able to borrow on as advantageous terms as formerly; that they have about reached the limit of their borrowing capacity on top of their present debt; and that they are not able to float their stocks, because of insufficient revenues to guarantee dividends commensurate with the risk.

Statisticians may make exhibits without end, but they can never overcome the fact that any company, be it a railroad, an industrial or a public utility company, can not have as good credit with a mortgage covering 65 per cent of the value of its property as it would have if its mortgage covered only 50 per cent of its property, and the increasing per cent of the interest-bearing debt must obviously affect its credit. This fact is aggravated by the large amount of short time obligations entering into the aggregate of its interest-bearing obligations.

While we have not laid any great stress in this case upon impaired credit, we do insist that the evidence shows that the ability of the carriers to borrow new or additional money and the ability of the carriers to raise money by the sale of stocks is greatly curtailed; that higher rates must be paid and that it is increasingly difficult to secure money from any of these sources. This, we believe, to be largely due to the fact of a declining net revenue.

TO WHAT RETURN ARE THE CARRIERS ENTITLED?

The only authoritative statement of the rate of return to which a carrier is entitled is found in the decisions of the courts in cases where the court has been asked to enjoin the enforcement of legislative acts or the orders of commissions, reducing rates or curtailing the revenues of the carrier. These cases must, of course, be based upon individual conditions, *i. e.*, the court can consider only the rate of return to be received by the particular line asking the injunction.

The question before the Commission, in considering an application of this kind, is, of course, much broader. This undoubtedly has been recognized by the commission, but we desire to suggest, in this connection, that when they are considering the reasonableness of rates, the rate of return upon a single line, or upon two or three lines, operating in a territory, can form no criterion as to whether or not the rates are reasonable. This is apparent from the fact that one line, under the same rates, may earn 8, 10 or 12 per cent. upon the value of its property, while another line may earn only 4 or 5 per cent upon the value of its property. It is in recognition of this fact that we have presented the matter as though all the lines in the territory were operated as one line. This must rest upon the assumption that the maintenance of these lines is all necessary and proper.

The carriers in this case have based their contention upon the right to earn at least 7 per cent upon the value of their property. In the Minnesota Rate Case, the circuit court held that the carriers in question in that case were entitled to earn at least 7 per cent upon the value of their property. While the case was reversed by the Supreme Court of the United States, the position of the circuit court as to the rate of return to which the companies were entitled was not reversed nor criticized. In a case, not yet reported, which has been decided, pending this present hearing, by the district court of Arkansas, it was held that the carriers in that section had the right to earn not less than 7½ per cent upon the value of their property. These and other cases indicate very clearly that the carriers in the territory in question, as a minimum, are entitled to 7 per cent upon the value of their property.

The advances in this case were expected to increase the revenues of the carriers by about $10,000,000 per year, as stated in the opening. The evidence and a more careful analysis of it discloses the fact that the estimate was too large. If the increase were $10,000,000 a year, it would make the full net operating income of these roads only $203,286,463.22, and would increase the rate of return by only a small fraction of one per cent. In round figures, the rate of return in 1914, if the proposed rates had been applied, would have been 4 per cent and such rate of return must be considered to be below anything that even the most radical could claim to be reasonable. It would not pay the interest on the bonds, assuming that 100 per cent value of the property could be bonded at the rate of interest accruing on the underlying mortgages.

In this connection, and to meet what appears to be the opinion of the Supreme Court in recent cases, the carriers have attempted to separate the costs of the freight and passenger business and ascertain the rate of return upon each class of business. There being no authoritative method for the separation of expenses the carriers used various methods and any or all of them are only approximate. We believe them to be such reasonable approximations that they may justly and rightly be used as the foundation for an opinion.

Under these bases, as shown by Exhibit 30, the ratio of expenses, including taxes, hire of equipment, etc., to revenue on the freight business, runs from 75.14 to 76.98, and the rate of return under these different bases, on the freight business, varies from 4.23 to 4.68 per cent, so that on any of the bases used there is such a margin of insufficiency of return as to render negligible any possible errors in the bases used.

HOW MAY THE REVENUES OF THE CARRIERS BE INCREASED

From this evidence, it seems that but one conclusion can be drawn, and that is, the increase in rates for the purpose of increase in revenues has been justified. If this conclusion is correct, it remains only to determine in what place and upon what commodities the advance shall be applied. It would be impracticable to make the advance of rates in either of the sections of the territory involved upon such commodities as grain, live stock and packinghouse products, without making a corresponding advance in the other portions of the territory

As to the selection of commodities, there will always be difference of opinion. The striking thing about this hearing has been that each protestant has been vigorous in asserting that the advance ought to be made on "the other fellow's commodity." The carriers in this case have exercised the best judgment they had, having in view the raising of additional revenue and the distribution of the additional charge to the public. The traffic managers familiar with their territory, know very well that there are certain commodities and classes of commodities that cannot stand an advance. If, therefore, there are certain rates which from competitive or commercial reasons, cannot be advanced so as to afford the same ratio of profit to the carriers as the other rates, it constitutes no reason for denying the advances on other commodities. Neither does this necessarily mean unjust discrimination.

The attempt in this case has been to select those commodities which will produce the needed revenue, with the least hardship, and to so distribute the advances that they may be borne by the

public generally, rather than by any separate class. It has not been thought practicable at the present time to advance the class rates in the western territory. They have been, many of them, fixed by orders of the commission, which would prevent an advance, and beyond that, the class rates in the western territory have not been so carefully and uniformly adjusted as in the east.

We beg leave to suggest that the act of Congress in relation to regulation of commerce fully contemplates that the carriers themselves shall retain the initiative in the matter of fixing rates, and the power of the commission is intended to be regulatory only, for the purposes of seeing that excessive or extortionate charges are not made by the carriers, and preventing undue or unjust discriminations. The law does not authorize the commission to fix rates. If, therefore, the initiative in fixing rates is to be left to the carriers, they must be allowed some discretion and must be expected to exercise that discretion within reasonable limits. It would seem that the duty of the commission in passing upon an application of this kind, somewhat general in its character, should be limited to the determination of whether the carriers have exercised a reasonable discretion.

A RECENT DEVELOPMENT IN RAILROAD FINANCE

By George A. Clark

The development of rail transportation in the United States can be conveniently studied from at least three points of view. There may be others, but certainly the problems of this industry fall into three natural groups; these are the physical and engineering problems arising from the construction and operation of the plant, the organization of the employees, and the development of the financial structure of the individual corporation. The latter is primarily of interest at this time because of the significance of a recent development to which as yet little attention has been given.

Capital has entered into the transportation industry in two forms, through the purchase of investors of either a share interest in the undertaking, having a more or less well-defined speculative value, or through the purchase of a fixed obligation (bonds), which generally has a rather well-defined investment value. It has not been feasible to develop a single important railroad system in the United States through the sale of capital stock alone. In every instance from one-third to two-thirds of the capital which has been required for the development of a given property, has been secured through the sale of bonds. Considering the needs of the industry and the resources of the country, it is a tribute to the financial genius of the early railroad promoters that such a large proportion of capital has entered the industry through sale of capital stock.

The sale of bonds for the purpose of inducing capital to enter the industry introduces a consideration of the various elements that have entered into this form of finance. During this period every conceivable modification and variety of obligation has been created to meet real or fancied needs. During the past three years, however, a definite form of obligation securing bond issues has been developed. An instrument has now been devised which meets the more exacting requirements of the state banking and insurance investment laws, and which appears to be adequate for the future needs of the industry. The "blanket mortgage" has at last reached a point where it appears reasonable to expect that there will be no further changes of consequence in the character of obligations of this kind.

Although the more recent "blanket mortgages" are in many ways an advance over the Great Northern first refunding mortgage securing the 4¼s of 1951, it can be said that the precedent in this line, as in many others, was established by James J. Hill when he asked his stockholders to authorize an issue of $600,000,000 bonds. Within the past year the Pennsylvania, the New York Central, the Chicago, Milwaukee & St. Paul, the Northern Pacific and the Erie have secured the approval of their stockholders, authorizing the creation of "blanket mortgages." The New Haven, the Baltimore & Ohio and the Southern legal and financial officers are now working on similar mortgages.

In a very significant sense, this new type of obligation appears to mark the end of the period of construction, consolidation and system building in the railroad development of the United States. A bond has been issued, secured by a mortgage, which appears to incorporate all of the essential features of the divisional, consolidated, refunding, convertible and debenture issued with few of the disadvantages inherent in all of them. In a very real sense of the character of the obligation created by the railroads during their development closely corresponds to the physical development of the business. Out of the great variety of obligations which have been created for the purpose of raising capital, the following may be considered as typical of the period and purpose served.

The first of these is the divisional mortgage of which there still remain a great number. As various pieces of track were projected, the most natural method of raising a part of the capital for the undertaking was to place a mortgage upon the specific piece of track under construction. As detached mileage was welded into through line, the equities in earnings and property values grew rapidly. Many obligations of this type are a favorite with the most conservative investment institutions. There are a few companies which still employ them, notably the Chicago & North Western, which within the past two years created two important mortgages of this kind, the Milwaukee, Sparta & North Western first 4s of 1947 and the St. Louis, Peoria & North Western first 5s of 1948. Both of these issues have since been assumed by the Chicago & North Western. As a type, however, with the refunding of the existing divisional mortgages they will disappear from railroad finance.

The welding of local operating units into through lines brought about the consolidated and unifying mortgage. This type of obligation allowed somewhat greater freedom in the development and expansion of the property than was possible with divisional mortgages. It could be used for refunding such issues, for construction or acquisition of new mileage, for the development of existing mileage and for the purpose of uniting independent properties into a single system. The Louisville & Nashville unified 4s of 1940 is an illustration of this type of bond issue. The consolidated mortgage afforded a method of bringing about one of the most important developments in the industry, namely, the consolidation of local units into through lines.

Closely parallel to the consolidated mortgage but following it as the demand for a more flexible financial instrument arose with the further development of the country, is the general refunding mortgage. This perhaps has been the most conspicuously successful of the various instruments employed to date. A number of well-known issues of this type have served the purpose for which they were created most admirably. Of these, some of the better known are the Chicago, Burlington & Quincy general 4s of 1958, the Chicago & North Western general 4s of 1987 and the Delaware & Hudson first and refunding 4s of 1943.

This type of issue has not been without certain marked disadvantages. The most noticeable of these has been the fixed interest rate common to most of them, the fixed authorized amount and burdensome restrictions as to issuance of bonds for other than refunding purposes. The fixed interest rate has frequently made it impossible for the company to sell bonds except at a prohibitive discount. The general lien 3s of 2047 of the Northern Pacific, and the Atlantic Coast Line unified 4s of 1959 are two instances in point. The general refunding mortgage bonds have been commonly limited as to the total authorized issue by some more or less arbitrarily fixed amount. In no important instance has the amount fixed been adequate.

The third occasion of difficulty in the use of these refunding issues has arisen from what have proven to be unnecessary and burdensome restrictions as to the issue of additional bonds and the absence of liberal provisions as to redemption, con-

vertibility, etc., all of which serve to adapt the issue to the period in which it must be sold. An instance illustrating the importance of this feature is found in the Chicago, Rock Island & Pacific first refunding 4s of 1934 where the amount issuable for additions and improvements to existing lines is limited to $2,500,000 per calendar year. This provision has had the effect of depriving the operating company of the Rock Island system of necessary capital for development of the plant. It has been an important but little recognized factor in bringing the system to the point where a drastic reorganization is necessary.

A number of additional types of obligations have been very extensively used, such as the debenture bond common to New England railroads, the convertible bond common to many of the stronger companies, the equipment trust note and the collateral trust bond.

The debenture has been used by a number of companies of good credit with conspicuous success. Notable among these, in addition to the New England roads, are the New York Central group, the Chicago, Milwaukee & St. Paul, and the Baltimore & Ohio.

The convertible bond has been an effective method of securing new capital without permanently increasing fixed charges. The Southern Pacific, the Norfolk & Western and the Atchison, Topeka & Santa Fe have used issues of this type to advantage. This is particularly true of the latter company, which since 1905 has only increased its funded debt from $275,000,000 to $319,146,000, or approximately 16 per cent. In the same period its outstanding capital stock has increased from $102,000,000 to $190,836,500, or more than 87 per cent.

The equipment trust notes has been quite generally used by all classes of companies. It is interesting to note in this connection that the western roads form a notable exception to this general practice. The Great Northern, the Northern Pacific, the St. Paul, the Union Pacific, Atchison and Southern Pacific have not used this form of obligation in recent years. As an investment security it has had a most fortunate record from the point of view of the investor.

The collateral trust bond has been primarily an instrument which has been used in the process of system building. Now that the conditions of the transportation industry have become practically stabilized, it will not be used in the future.

Each of the above obligations has served an important part in the development of the financial structures of the railroads, but with the coming of the "blanket mortgage" in the case of the railroads with the better credit at least, it seems probable that they will gradually fall into disuse.

The last step in this process is the "blanket mortgage" variously known as general and refunding, improvement and refunding, etc. The more important characteristics of this type of mortgage are as follows:

The limit to the authorized issue with the exception of the Pennsylvania and the Erie, has been placed at three times the outstanding capital stock. In the case of the Pennsylvania, it is fixed at an amount equal to the capital stock; in the case of the Erie, it has been limited to $600,000,000. The bonds issuable under the mortgage are secured by a direct lien, with minor exceptions, upon the entire property of the company now owned or hereafter acquired. Bonds may be issued in series, the interest rate in no case to exceed 5 or 6 per cent. After the refunding of all existing issues and the use of from $200,000,000 to $300,000,000 additional further bonds can only be issued to pay for new work at from 75 to 80 per cent of its cost, and upon approval of stockholders for each issue or series.

The following comparative table illustrates clearly the remarkable uniformity in the leading provisions of these issues:

COMPARISON OF SALIENT PROVISIONS IN LATEST TYPE OF RAILROAD "BLANKET MORTGAGE" BONDS

	Company			
Provision	Pennsylvania	N. Y. C. & H.	C. M. & St. P.	N. P.
Maturity	100 years from date.	100 years from date.	100 years from date.	133 years from date.
Interest rate	Provision not announced.	To be fixed by company for each series.	To be fixed by company for each series, but cannot exceed 6 per cent.	To be fixed by company for each series, but cannot exceed 6 per cent.
Issuable in Series	Upon vote of stockholders approving each issue.	After $500,000,000 have been issued no additional bonds may be issued except for refunding purposes, unless authorized by stockholders.	Without restrictions.	After $500,000,000 have been issued no additional bonds may be issued except for refunding purposes, unless authorized by stockholders.
Authorized Issue	Limited to an amount *equal* to outstanding capital stock.	Limited to *three* times outstanding capital stock.	Limited to *three* times outstanding capital stock.	Limited to *three* times outstanding capital stock.
Smallest denomination issuable under terms of indenture	Not announced.	$500	$100	$100
Redeemable	Not announced.	Any series may be redeemed as a whole on terms to be stated on each bond.	Any series may be redeemable upon terms stated on the bond.	Any series may be redeemable as a whole upon terms stated on bond.
Convertible	Not announced.	Any series may be made convertible into capital stock.	Any series may be made convertible into capital stock.	No provision.
Further Provision	Not announced.	After $500,000,000 bonds have been issued, not including refunding, bonds can only be issued for new construction on property acquired at 80 per cent of cost.	After $226,961,600 bonds have been issued, not including refunding, bonds can only be issued for new construction on property acquired at 75 per cent of cost.	After $500,000,000 bonds have been issued, including bonds for refunding purposes, additional bonds can only be issued for 80 per cent of cost of new construction on property acquired.
Nature of lien	Direct lien on all property of company with minor exceptions.	Direct lien on all property of company with minor exceptions.	Direct lien on all property of company with minor exceptions.	Direct lien on all property of the company with minor exceptions.
Bonds issued to date	None	$40,000,000	$30,000,000	$20,000,000

Comparing this type of mortgage instrument with the various mortgages which have been drawn in the past, it appears to have successfully overcome the most obviously difficult of those indentures from the point of view of the railroad company at least. All of the issues under consideration run for 100 years or more. In no case is a fixed interest rate provided, thus insuring a degree of flexibility to cope with the problem of shifting investment conditions. The ratio of debt to capital stock has been fixed upon most liberal terms rather than limiting the issue to a fixed authorized amount. The principle of a fixed ratio to capital stock or share interest has been adopted rather than fixing a definite amount. Provisions as to redemption, convertibility, etc., have been satisfactorily provided.

From the point of view of the corporation, the blanket mortgage provides complete freedom for future development.

From the point of view of the investor but one serious criticism can be directed against this type of finance. Too great latitude has been allowed in the creation of debt in ratio to capital stock. Undoubtedly the Pennsylvania has taken the wisest position on this point. The tendency, however, is to take advantage of the widest latitude allowed by the investment

laws of New York, Massachusetts and Connecticut. The reception which investors have accorded the obligations which have been offered during the past year would not indicate any serious disapproval of this feature, however.

With characteristic foresight the Pennsylvania was one of the first to secure approval of stockholders for an issue of this character, although as yet no bonds have been offered under it.

The New York Central & Hudson River in April, 1914, made the first public offering, with a total of $40,000,000 refunding and improvement 4½s of 2014 on a 4.70 per cent basis. The issue was well taken, according to the report of bankers.

The Chicago, Milwaukee & St. Paul followed in June of last year with an issue of $30,000,000 general and refunding 4½s of 2014. In this instance the bankers acted as an agent for the company. No commitment was made, the bankers receiving a commission of ½ point for all bonds sold. In spite of the unusual circumstances surrounding the offering, the issue appeared to go well on a 4.68 per cent basis. In January of this year $30,000,000 additional were offered to stockholders on a 5 per cent basis. This issue was made convertible. In July, 1914, $20,000,000 Northern Pacific refunding and improvement 4½s of 2047 on a 4.64 per cent basis were taken in an unusually short time.

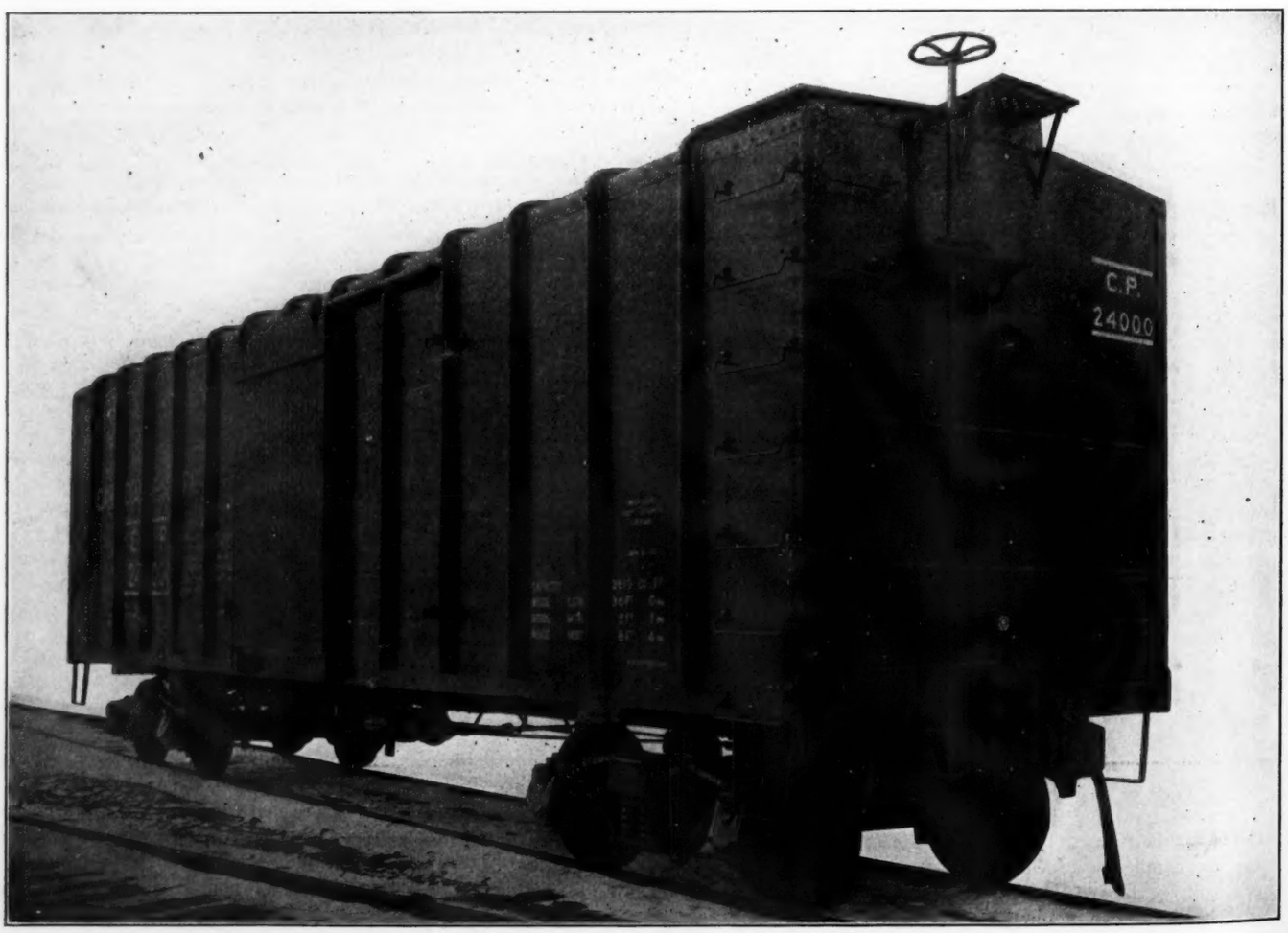
It is of interest to consider this type of financing with reference to the industry as a whole. These instruments represent the last word in the effort of those responsible for the financial well-being of our railroads to provide a dependable and attractive bond serviceable alike to both the company and the investor.

Ultimately the mortgage debt of American railroads, assuming that private ownership of these properties is to continue, will be greatly simplified. The size of the issues should make a better market for this type of bond than is possible with many comparatively small issues outstanding. The provision allowing for the issue of such bonds in denomination of $100 adequately provides for the development of the small investor, one of the most important factors with reference to the future.

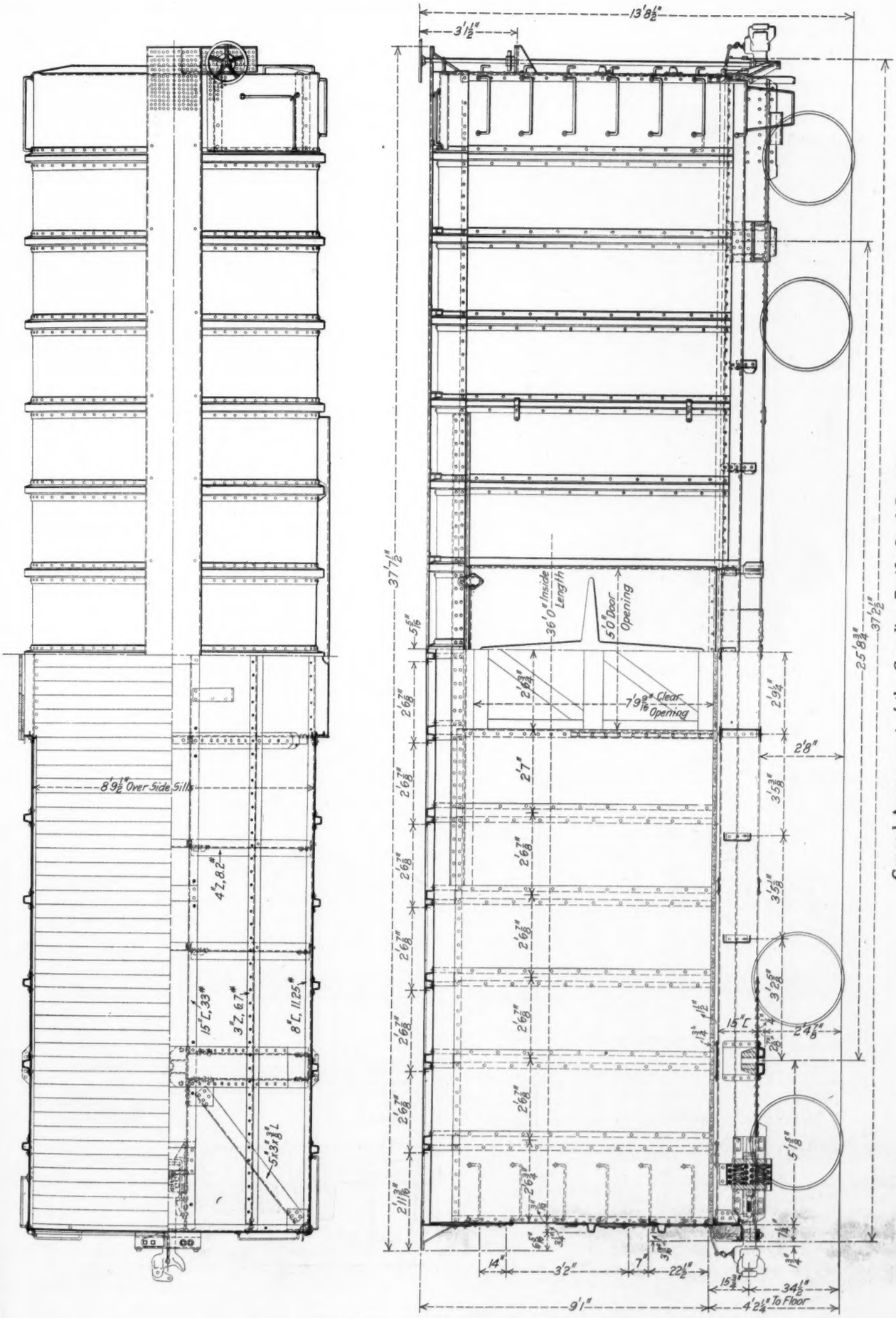
STEEL BOX CAR FOR THE CANADIAN PACIFIC

An all-steel box car recently designed and built by the Canadian Car & Foundry Company, Montreal, Que., and now in service on the Canadian Pacific, is shown in the accompanying engravings. The car weighs 37,000 lb., and has an inside length of 36 ft., with a clear inside width of 8 ft. 8 in.

The construction of the car body is such that the interior surface is smooth, there being no braces employed in the side and end frames. The side posts are formed by pressing one vertical edge of each side sheet into a U section and are spaced 2 ft. 6⅞ in. between centers. The portion of the side sheets forming these posts is also offset to lap over the flat edge of the adjoining plate. A similar construction is employed in forming the roof members, the pressed U section in the roof sheets being made to correspond and to lap over the side sheets, thus practically forming a continuous post from side sill to side sill. As shown in the illustrations, these combined posts and carlines are on the exterior of the car, leaving a smooth interior which helps increase the loading space and makes the car easy to clean. The side plates are 3/16 in. thick and the roof plates are ⅛ in. thick, while the end plates are 3/16 in. thick and are reinforced by horizontal stiffeners of U-shaped section. Two sliding doors are provided in one end of the car to facilitate the loading of lumber



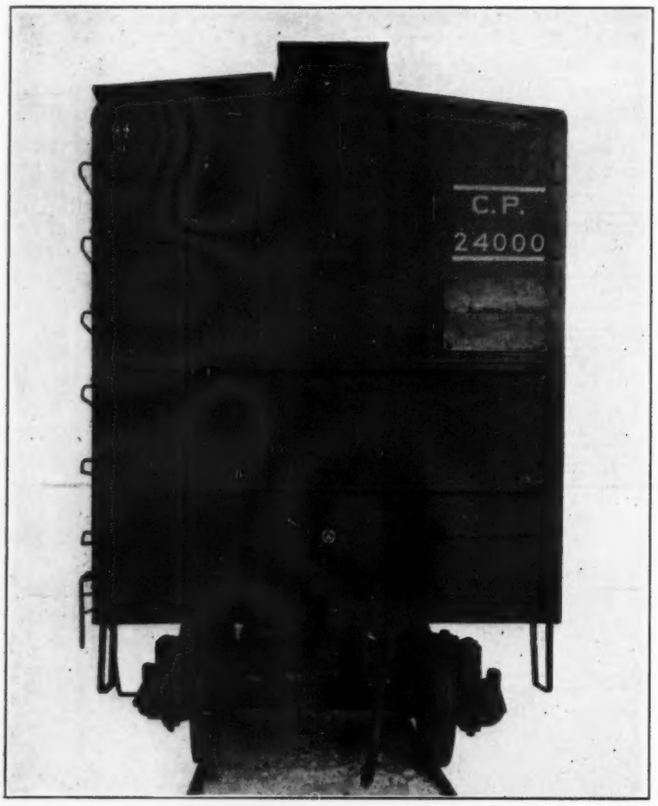
All-Steel Box Car Recently Built for the Canadian Pacific



General Arrangement of the Canadian Pacific Steel Box Car

and other long material. The running board is supported on angles riveted to the roof sheet.

The car is 37 ft. 2½ in. long over the buffer blocks on the end



End View of the Steel Box Car

sills and the distance between center plates is 25 ft. 8¾ in. The center sills are 15-in., 33-lb. channels, which are connected by channel-section distance pieces, spaced at 3 ft. 5⅛ in. intervals, and by plates at various points throughout the length of the car, there being no cover plates employed except on the under side for a short distance at the body bolsters. The body bolsters are built up of ¼-in. pressed steel webs or fillers with ½-in. top cover plates and ½-in. bottom cover plates. There are two cross-bearers placed 2 ft. 9¼ in. on either side of the center line of the car and built up of ¼ in. pressed fillers with ½-in. top cover plates and ½-in. bottom cover plates. The side sills are 8-in. 11.25-lb. channels and there are 5-in. by 3-in. by ⅜-in. diagonal bracing angles at the ends of the car, between the junction of the side and end sills at the corner of the car and the junction of the body bolster and the center sills. The center and the side sills are connected by 4-in., 8.2-lb. Z-bars and these support a 3-in., 6.7-lb. Z-bar placed about midway between the side and the center sills on both sides of the car, which acts as a floor stringer. The end sills are built up of steel plates and angles.

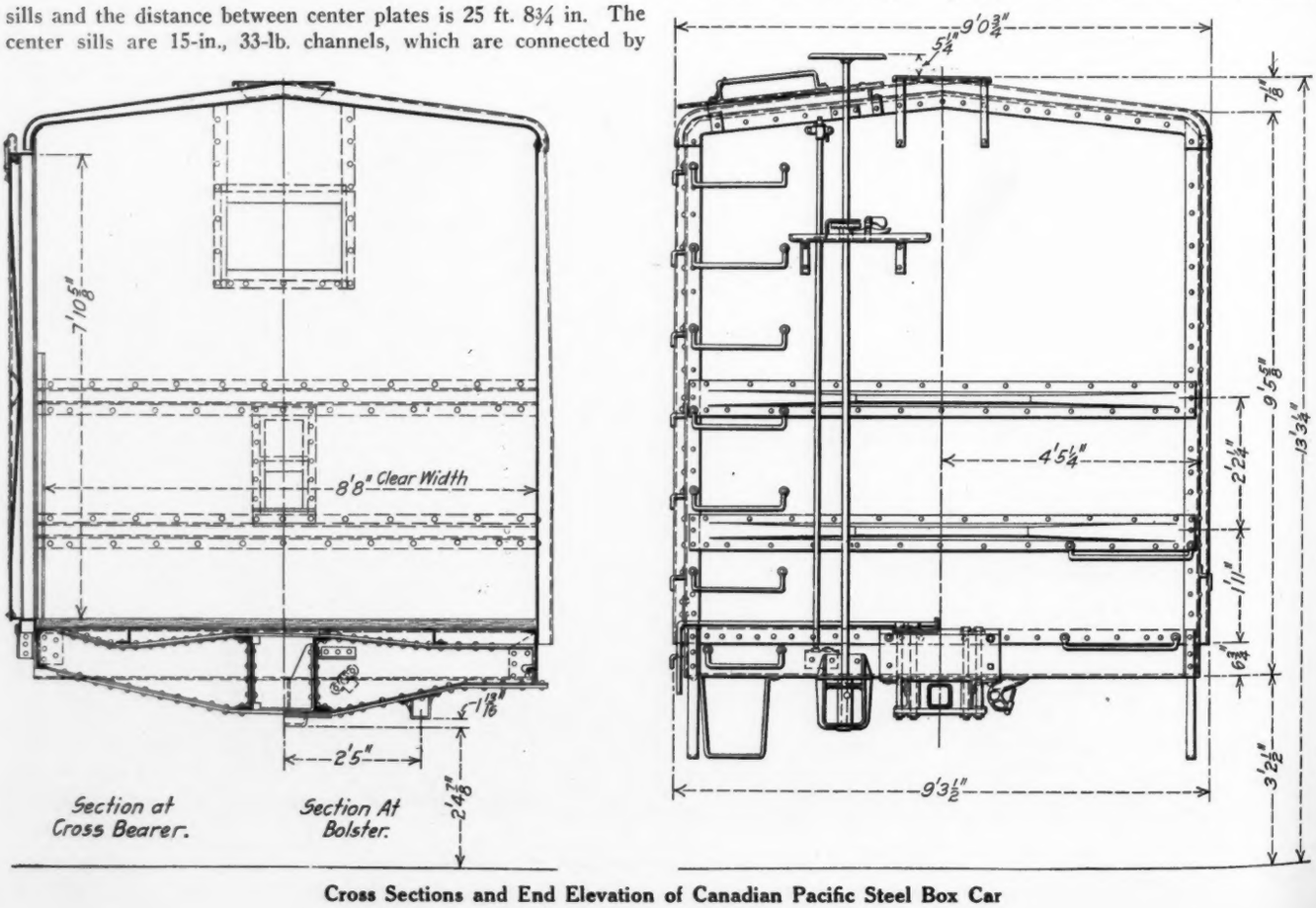
The drawings show provision for a steel door, but a wooden door was used on the car as shown in the photograph. The capacity of the car is 80,000 lb.

THE FRENCH RAILWAYS IN WAR TIME

The following account taken from an article on the subject in the *Journal des Transports* shows how the French railways are managed in time of war and indicates the efforts made to have them in readiness at the required moment.

Article 54 of the *Cahier des Charges* (specifications) under which the French railways operate, provides that if the government has to transport troops and supplies to any place served by a railway, the companies must immediately place all their facilities at the service of the state. This obligation has existed for over 40 years, so that before the war, a permanent military organization had been created whose duties were to prepare the railways for service in time of war.

Each of the large railways has attached to it a committee, the *commission de réseau*, composed of a technical member, usually



Cross Sections and End Elevation of Canadian Pacific Steel Box Car

the general manager, and a military member, a high officer of the general staff, nominated by the minister of war. The duties of this committee are to investigate in all its bearings, and with a view to strategic requirements, the manner in which the tracks and rolling stock and such special details as military platforms, stopping places for meals, etc., can be utilized in conformity with the needs of the war office.

Besides these individual *commissions de réseau,* there is a superior military railways committee. This body, which was created by a ministerial decree of 1898, is presided over by the chief of the general staff, and is composed of six generals or other officers of high rank, three representatives of the ministry of public works and the members of the above-described *commissions.* Its functions are advisory; it records its opinions concerning any measures proposed by the *commissions de réseau,* as well as on all questions relative to military transport.

On the declaration of war, there are special regulations affecting railway employees. These provide that if a railway man is called to the colors, he is mobilized as a railway man and on a territorial system whereby men employed by the same company are grouped together into regimental units. All these arrangements are worked out in time of peace. They were tested during the railway strike of 1910, when the men were called out under martial law, and for the time being became in effect soldiers whose duties were confined to railway work.

On the first day of mobilization, after having been duly notified by the minister of war, the railways must place at the disposal of the military authorities every available facility on certain divisions, or on the whole system, as the case may be. The railway system of the country is then divided into two "zones," under different authorities. Both are under military control. The "interior zone" comes under the ministry of war; the minister and the general staff regulating conditions of traffic. Under the authority of the minister, the *commission de réseau* of each line handles executive functions and each of the two members retains his individual responsibilities, one being entrusted with military measures, while the technical member sees to it that all requirements for the provision of rolling stock and other matters connected with actual operation are met. They are aided by subcommittees, each of which is also composed of a military and a technical member.

The "army zone" is under the control of the commander-in-chief of the armies in the field, assisted by an officer whose status is that of manager of the army railways. This zone is naturally sub-divided, a distinction being made between sections of line without and within the actual scene of military operations. The lines within the former zone are manned by the employees of the company concerned, organized under the territorial scheme referred to above. Within the zone of actual field operations the service is carried on by military units corresponding more or less with army engineers.

Precedence is naturally given to military requirements, but provision must be made for transporting foodstuffs and general commercial merchandise. Within the "army zone" ordinary traffic is suspended altogether, save for such exceptions as may be authorized by the commander-in-chief. In the "interior zone," such traffic is conducted exclusively according to the conditions prescribed by the ministry of war, which is empowered, after mobilization and concentration are completed, and on the request of the *commissions de réseau,* to authorize the partial or complete resumption of ordinary passenger and freight traffic. Throughout the duration of war, the railways must insure the conveyance of all military traffic under the best possible conditions.

FEMALE BOOKING CLERKS ON THE METROPOLITAN RAILWAY OF ENGLAND.—In common with many other companies, the Metropolitan Railway has now female booking clerks at several of its stations and is rapidly increasing the number in order to relieve men for other duties and to enable them to join the forces.

ANNUAL GOVERNMENT SIGNAL BULLETIN

On following pages we reprint Table No. 1 from the annual statistical report of block and interlocking signals on the railroads of the United States issued by the Interstate Commerce Commission, giving the mileage of road equipped, with other data, as of January 1, 1915.

The changes in total length of road signaled, as compared with January 1, 1914, are as follows:

Miles of Railroad on Which the Block System Is in Use

	Jan. 1, 1915	Jan. 1, 1914	Jan. 1, 1913
Automatic	29,600.0†	26,569.3	22,218.8
Manual	66,679.1†	60,167.6	61,731.0
Total	96,279.1†	86,736.9	83,949.8
Changes*—			
Automatic	I. 3,030.7	I. 4,350.5	
Manual	I. 6,511.5	D. 1,563.4	

The increase in mileage of road equipped with automatic block signals, as shown in the table, 3,030 miles, is less than the actual increase, because the total as given for the preceding year has not been corrected by deducting the duplicated items. The more important increases both in automatic and manual signaling are set forth in a separate table in the bulletin, which is reprinted below. The two largest items in the increase in manual signaling, the Southern Pacific and the New York, New Haven & Hartford, did not appear in the reports received by the *Railway Age Gazette,* and therefore were not counted in the totals published by us on January 1. The New Haven statement was corrected in a subsequent issue; but the ex-

Name of railroads.	Increase.		Decrease.
	Automatic.	Nonautomatic.	Nonautomatic.
	Miles.	*Miles.*	*Miles.*
Atchison, Topeka & Santa Fe: Coast Lines	123.1		
Atlantic Coast Line	81.6		88.9
Boston & Maine	73.0		
Brockton & Plymouth Street [1]		22.6	
Buffalo, Rochester & Pittsburgh	74.3		80.7
Canadian Pacific [1]		200.3	
Chattanooga Railway & Light [1]	28.5		
Chesapeake & Ohio and Chesapeake & Ohio of Indiana		76.8	
Chicago & North Western	151.2		181.6
Chicago, Burlington & Quincy	111.4		
Chicago, Milwaukee & St. Paul	483.0		468.8
Bellingham & Northern [1]		55.1	
Gallatin Valley [1]		48.1	
Idaho & Washington Northern [1]		111.7	
Chicago, South Bend & Northern Indiana [1]	10.0		
Duluth, South Shore & Atlantic [1]		24.4	
El Paso & Southwestern	60.1		
Erie	42.6		72.6
Chicago & Erie	205.3		205.3
Fort Dodge, Des Moines & Southern [1]	16.4		
Hocking Valley [1]	1.9	99.1	
Illinois Traction	41.8		
Lehigh & Hudson River	49.7		
Lehigh Valley	55.8		49.6
Louisville & Nashville	91.5		92.2
Massachusetts Northeastern Street [1]	100.8		
Mineral Point & Northern [1]		26.4	
Mobile & Ohio	7.1		36.1
New York Central Lines:			
Cincinnati Northern [1]		202.8	
Toledo & Ohio Central		126.7	
New York, New Haven & Hartford		956.2	
New York, Westchester & Boston [1]	18.0		
Northern Pacific	189.7		229.2
Oakland, Antioch & Eastern [1]	82.1		
Oregon-Washington Railroad & Navigation	187.0		
Panama [1]	47.5		
Pere Marquette	57.2		7.6
Piedmont & Northern [1]	4.3	126.2	
Portland Railway, Light & Power [1]	20.6		
Queen & Crescent Route:			
Alabama Great Southern	135.2		128.1
Southern	100.9		
Southern Pacific—Sunset Central Lines:			
Galveston, Harrisburg & San Antonio		1,233.7	
Houston & Shreveport [1]		39.8	
Houston & Texas Central [1]	2.9	814.5	
Houston, East & West Texas [1]	2.7	188.2	
Lake Charles & Northern [1]		44.3	
Louisiana Western		198.3	
Morgan's Louisiana & Texas		279.3	
Texas & New Orleans		397.7	
Southern Pacific—Pacific System	67.7	3,477.9	
Terre Haute, Indianapolis & Eastern Traction [1]	47.6		
Union Traction of Indiana [1]	49.9		
Western Maryland [1]	62.0		
Total	2,884.4	8,749.1	1,640.7

[1] Roads which have not heretofore reported block-signal mileage.

*Increase or Decrease compared with preceding year.

†From the totals in Table 1 there are deducted, for joint mileage reported by two companies, 263.5 miles of automatic and 66 miles manual.

MILEAGE OF RAILWAYS OPERATED UNDER THE BLOCK SYSTEM, JANUARY 1, 1915

Names of railroads.	Automatic block signals.						Nonautomatic block signals.						Total automatic and nonautomatic.		Total passenger lines operated.		Per centage block signaled, miles of track.
	Single track.	Double track.	Three track.	Four track.	Total. Miles of road.	Total. Miles of track.	Single track.	Double track.	Three track.	Four track.	Total. Miles of road.	Total. Miles of track.	Miles of road.	Miles of track.	Miles of road.	Miles of track.	
Albany Southern	0.5				0.5	0.5	26.7	16.3			43.0	59.3	43.5	59.8	43.5	59.8	100.0
Ann Arbor							1.0				1.0	1.0	1.0	1.0	293.8	293.8	.3
Arizona & New Mexico	1.0				1.0	1.0							1.0	1.0	109.0	109.0	.9
Atchison, Topeka & Santa Fe System:																	
Eastern lines	21.5	118.8			140.3	259.1	459.0	486.8			945.8	1,432.7	1,086.1	1,691.8	2,693.0	3,332.5	50.7
Western lines	5.5	2.5			8.0	10.5	557.4	23.8			581.2	605.0	589.2	615.5	2,985.6	3,016.6	20.4
Coast lines	73.3	319.7			393.0	701.0	4.3				4.3	4.3	397.3	705.3	2,144.3	2,458.8	28.6
Gulf, Colorado & Santa Fe	21.1				21.1	21.1							21.1	21.1	1,698.5	1,702.8	1.2
Atlanta & West Point								6.0			6.0	12.0	6.0	12.0	86.0	92.0	13.0
Atlantic Coast line	11.3	249.4			260.7	510.1	249.3	13.2			262.5	275.7	523.2	785.8	3,745.3	4,000.5	19.6
Auburn & Northern Electric	6.5				6.5	6.5							6.5	6.5	6.5	6.5	100.0
Baltimore & Ohio System:																	
Baltimore & Ohio	38.0	322.7	2.8	15.1	378.6	757.7	1,921.3	679.8	114.2	10.5	2,725.9	3,682.4	3,104.6	4,440.1	3,104.6	4,440.1	100.0
Baltimore & Ohio Chicago Terminal	1.2	20.0			21.2	40.6							21.2	40.6	43.5	71.3	57.0
Baltimore & Ohio Southwestern	35.1	24.9			60.0	84.8	866.7	36.5			903.2	939.7	963.2	1,024.5	963.2	1,024.5	100.0
Cincinnati, Hamilton & Dayton	118.4	27.0			145.4	172.4	744.0	24.3			768.3	792.6	913.7	965.0	913.7	965.0	100.0
Staten Island	.8	22.1		.6	23.5	47.4							23.5	47.4	23.5	47.4	100.0
Baltimore, Chesapeake & Atlantic							87.0				87.0	87.0	87.0	87.0	87.0	87.0	100.0
Bangor & Aroostook	5.6				5.6	5.6							5.6	5.6	576.7	607.0	.9
Bessemer & Lake Erie							65.1	129.5			194.6	324.1	194.6	324.1	191.4	320.8	98.2
Boston & Maine	509.2	618.9	3.4	2.1	1,133.6	1,765.6							1,133.6	1,765.6	2,212.8	2,793.7	63.2
Boston, Revere Beach & Lynn		13.8			13.8	27.6							13.8	27.6	13.8	27.6	100.0
Brockton & Plymouth Street	.4				.4	.4	22.6				22.6	22.6	23.0	23.0	23.0	23.0	100.0
Buffalo, Rochester & Pittsburgh	139.6	84.1			223.7	307.7	174.8	60.6			235.5	296.1	459.2	603.9	443.8	588.6	100.0
Butte, Anaconda & Pacific	7.9				7.9	7.9							7.9	7.9	58.0	58.0	13.6
Canadian Pacific							200.3				200.3	200.3	200.3	200.3	200.3	200.3	100.0
Carolina & North Western							2.4				2.4	2.4	2.4	2.4	133.5	133.5	1.8
Carolina, Clinchfield & Ohio, and Carolina, Clinchfield & Ohio of South Carolina	11.0				11.0	11.0							11.0	11.0	256.0	256.0	4.3
Central New England	2.7	34.4			37.1	71.5		34.3			34.3	68.6	71.4	140.1	296.9	368.9	37.9
Central of Georgia							47.9	7.4			55.3	62.7	55.3	62.7	1,767.3	1,774.7	3.5
Central of New Jersey	40.6	165.6	2.4	33.5	242.1	521.4							242.1	521.4	459.9	753.2	69.2
Centrsl Vermont							396.3	6.2			402.5	408.7	402.5	408.7	402.5	408.7	100.0
Chattanooga Railway & Light	28.5				28.5	28.5	1.8				1.8	1.8	30.2	30.2	46.1	61.5	49.1
Chesapeake & Ohio and Chesapeake & Ohio of Indiana		454.6			454.6	909.2	1,607.7	21.2			1,628.9	1,650.1	2,083.5	2,559.3	2,083.5	2,559.3	100.0
Chesapeake Beach							1.8				1.8	1.8	1.8	1.8	28.3	28.3	6.0
Chicago & Alton	410.9	187.3			598.2	785.5	106.1	36.6			142.7	179.3	740.9	964.8	1,025.2	1,209.8	79.7
Chicago & Eastern Illinois	57.8	154.2			212.0	366.2	181.1	32.4			213.5	245.9	425.5	612.1	1,005.7	1,214.6	50.4
Chicago & North Western	209.7	804.3	14.9	8.3	1,037.2	2,099.1	2,533.4	27.3			2,560.8	2,588.1	3,598.0	4,687.2	7,266.9	8,338.8	56.2
Chicago & Western Indiana		20.5			20.5	41.0		3.6	3.2		6.8	16.8	27.3	57.8	27.3	57.8	100.0
Chicago, Burlington & Quincy	166.7	37.1	30.6	5.4	239.8	354.3	7,962.2	772.7	7.2		8,742.1	9,529.2	8,981.9	9,883.5	9,324.8	10,309.0	100.0
Chicago Great Western	256.5	89.6			346.1	435.7	48.6				48.6	48.6	394.7	484.3	1,338.2	1,443.6	33.5
Chicago, Indianapolis & Louisville	294.1				294.1	294.1							294.1	294.1	578.0	578.0	50.9
Chicago Junction							1.1				1.1	1.1	1.1	1.1	11.8	163.7	.7
Chicago, Milwaukee & St. Paul	365.4	839.8			1,205.2	2,050.1	3,078.1	143.9			3,222.0	3,365.9	4,427.2	5,416.0	8,548.0	9,543.0	56.8
Bellingham & Northern							55.1				55.1	55.1	55.1	55.1	55.1	55.1	100.0
Gallatin Valley							48.1				48.1	48.1	48.1	48.1	48.1	48.1	100.0
Idaho & Washington Northern							111.7				111.7	111.7	111.7	111.7	111.7	111.7	100.0
Tacoma & Eastern							75.8				75.8	75.8	75.8	75.8	75.8	75.8	100.0
Chicago, Ottawa & Peoria	15.9				15.9	15.9							15.9	15.9	107.9	107.9	14.7
Chicago, Peoria & St. Louis							247.2				247.2	247.2	247.2	247.2	247.2	247.2	100.0
Chicago, Rock Island & Pacific	658.1	283.1			941.2	1,224.3	1,087.3				1,087.3	1,087.3	2,028.5	2,311.6	7,568.0	7,847.1	29.4
Chicago, Rock Island & Gulf	32.6				32.6	32.6							32.6	32.6	472.7	472.7	6.9
Chicago, St. Paul, Minneapolis & Omaha	27.2	171.5			198.8	370.4	463.4	.6			464.0	464.7	662.9	835.1	1,574.2	1,757.2	47.5
Chicago, South Bend & Northern Indiana	10.0				10.0	10.0							10.0	10.0	67.0	67.0	14.9
Chicago, Terre Haute & Southeastern	1.5				1.5	1.5							1.5	1.5	178.5	188.2	.8
Colorado Midland							2.0				2.0	2.0	2.0	2.0	261.1	261.1	.8
Columbia & Puget Sound	10.0	8.9			18.9	27.8							18.9	27.8	50.8	61.2	45.4
Copper Range							78.7				78.7	78.7	78.7	78.7	78.7	78.7	100.0
Cornwall & Lebanon							8.8	13.2			22.0	35.2	22.0	35.2	22.0	35.2	100.0
Cumberland & Pennsylvania							4.3		3.0		7.3	13.3	7.3	13.3	31.3	37.3	35.6
Cumberland Valley	5.8	52.1			57.9	110.0	105.0				105.0	105.0	162.9	215.0	163.7	221.6	97.0
Delaware & Hudson	164.2	225.2	4.3	17.5	411.2	697.5		34.6			34.6	69.2	445.8	766.7	722.0	1,089.6	70.3
Delaware, Lackawanna & Western	280.5	476.0	43.3	23.3	823.2	1,456.0	8.8				8.8	8.8	832.1	1,464.8	930.0	1,553.1	94.3
Denver & Salt Lake							34.1				34.1	34.1	34.1	34.1	214.1	214.1	16.0
Duluth & Iron Range		17.1			17.1	18.5							17.1	18.5	200.0	274.1	6.7
Duluth, South Shore & Atlantic							24.4				24.4	24.4	24.4	24.4	518.6	518.6	4.7
Durham & Southern							56.9				56.9	56.9	56.9	56.9	59.0	59.0	96.8
Eastern Kentucky							4.5				4.5	4.5	4.5	4.5	36.0	36.0	12.5
Elgin, Joliet & Eastern	7.0	3.0			10.0	10.0	9.1				9.1	9.1	19.1	19.1	(1)	(1)	.....
El Paso & Southwestern System	159.3				159.3	159.3							159.3	159.3	816.8	816.8	19.5
Erie	15.2	620.0		14.8	650.0	1,314.4	528.9	207.6			736.5	944.1	1,386.5	2,258.5	1,698.5	2,570.5	87.8
Chicago & Erie		205.3			205.3	410.6	35.0	8.4			43.4	51.8	248.7	462.4	248.7	462.4	100.0
Columbus & Erie							13.2				13.2	13.2	13.2	13.2	(1)	(1)	.....
Erie & Jersey		38.6			38.6	77.2							38.6	77.2	(1)	(1)	.....
Genesee River							32.6				32.6	32.6	32.6	32.6	(1)	(1)	.....
New Jersey & New York	10.2	10.5			20.7	31.2							20.7	31.2	36.5	47.0	66.4
New York, Susquehanna & Western		4.9			4.9	9.8	32.0	13.7			45.7	59.4	50.6	69.2	209.4	218.0	31.7
Fort Dodge, Des Moines & Southern	16.4				16.4	16.4							16.4	16.4	119.3	119.3	13.7
Grand Trunk Railway System							3.1	.2			3.3	3.5	3.3	3.5	3.3	3.5	100.0
Atlantic & St. Lawrence							170.9	1.2			172.1	173.4	172.1	173.4	172.1	173.4	100.0
Champlain & St. Lawrence							1.2				1.2	1.2	1.2	1.2	1.2	1.2	100.0
Chicago, Detroit & Canada Grand Trunk Junction							61.5				61.5	61.5	61.5	61.5	52.8	52.8	100.0
Cincinnati, Saginaw & Mackinaw							60.5				60.5	60.5	60.5	60.5	60.5	60.5	100.0
Detroit, Grand Haven & Milwaukee							190.5				190.5	190.5	190.5	190.5	190.5	190.5	100.0
Grand Trunk Western		78.2			78.2	156.4	18.5	245.2			263.8	509.0	342.0	665.4	342.0	665.4	100.0
International Bridge Co.							.4				.4	.4	.4	.4	.4	.4	100.0
Michigan Air Line							105.6				105.6	105.6	105.6	105.6	105.6	105.6	100.0
Pontiac, Oxford & Northern							118.8				118.8	118.8	118.8	118.8	118.8	118.8	100.0
St. Clair Tunnel Co.							1.5				1.5	1.5	1.5	1.5	1.5	1.5	100.0
Toledo, Saginaw & Muskegon							95.9				95.9	95.9	95.9	95.9	95.9	95.9	100.0
United States & Canada							22.5				22.5	22.5	22.5	22.5	22.5	22.5	100.0
Great Northern	188.6	346.3			534.9	881.2	319.9	.1			320.0	320.1	854.9	1,201.3	7,144.4	7,368.8	16.3
Hocking Valley		1.9			1.9	3.8	237.5				237.5	237.5	239.4	241.3	336.9	390.2	61.8
Hudson & Manhattan	1.1	7.8			8.9	16.8	1.9				1.9	1.9	10.8	18.7	10.8	18.7	100.0
Huntingdon & Broad Top Mountain	5.4				5.4	5.4							5.4	5.4	49.2	49.2	10.9
Illinois Central	181.0	405.9		26.8	613.7	1,119.7	6.0				6.0	6.0	619.7	1,125.7	4,514.6	5,353.0	21.0
Yazoo & Mississippi Valley	14.8	.2			15.0	15.1							15.0	15.1	1,214.6	1,241.3	1.2
Illinois Traction	124.1	1.5			125.6	127.1							125.6	127.1	443.1	452.6	28.1
International	4.6				4.6	4.6							4.6	4.6	33.7	44.0	10.5
Kanawha & Michigan	1.8				1.8	1.8	2.3				2.3	2.3	4.1	4.1	163.9	163.9	2.5
Kansas City Terminal		6.8			6.8	13.5							6.8	13.5	14.2	22.5	60.0
Kentucky & Indiana Terminal							3.0	8.2			11.2	19.4	11.2	19.4	11.2	19.4	100.0
Kentwood & Eastern							3.4				3.4	3.4	3.4	3.4	29.8	29.8	11.4
Lackawanna & Wyoming Valley								1.5			1.5	3.0	1.5	3.0	22.6	43.4	6.9

[1] Freight Line.

MILEAGE OF RAILWAYS OPERATED UNDER THE BLOCK SYSTEM, JANUARY 1, 1915—CONTINUED

Names of railroads.	Automatic block signals.						Nonautomatic block signals.						Total automatic and nonautomatic.		Total passenger lines operated.		Per cent-age block signaled, miles of track.
	Single track.	Double track.	Three track.	Four track.	Total.		Single track.	Double track.	Three track.	Four track.	Total.						
					Miles of road.	Miles of track.					Miles of road.	Miles of track.	Miles of road.	Miles of track.	Miles of road.	Miles of track.	
Lehigh & Hudson River	73.3				73.3	73.3	.3				.3	.3	73.6	73.6	73.6	73.6	100.0
Lehigh & New England	2.9				2.9	2.9							2.9	2.9	73.5	75.7	3.8
Lehigh Valley	71.3	432.0	51.4	31.3	586.0	1,214.7	593.4	52.4			645.8	698.2	1,231.8	1,912.9	1,218.2	1,898.1	100.0
Ligonier Valley							14.3				14.3	14.3	14.3	14.3	14.3	14.3	100.0
Long Island		95.8	3.3	14.5	113.6	262.7	29.7	9.8			39.5	49.3	153.1	312.0	360.9	537.7	58.0
Louisville & Nashville	214.7	55.8			270.5	326.3	102.2	55.4			157.6	213.1	428.1	539.4	4,564.9	4,919.3	10.9
Louisville & Northern Railway & Light	4.1				4.1	4.1							4.1	4.1	16.3	17.1	23.9
Maine Central	437.0	63.0			500.0	563.0							500.0	563.0	1,103.0	1,166.5	48.3
Portland Terminal	5.0	11.9			16.9	28.8							16.9	28.8	19.7	32.5	88.6
Maryland, Delaware & Virginia							77.4				77.4	77.4	77.4	77.4	77.4	77.4	100.0
Massachusetts Northeastern Street	100.8				100.8	100.8							100.8	100.8	116.6	119.8	84.1
Mineral Point & Northern							26.4				26.4	26.4	26.4	26.4	26.4	26.4	100.0
Mineral Range							4.7				4.7	4.7	4.7	4.7	77.3	77.3	6.1
Minneapolis & St. Louis		4.0			4.0	8.0	11.3				11.3	11.3	15.3	19.3	1,537.4	1,547.3	1.2
Minneapolis, St. Paul & Sault Ste. Marie							1,409.9	12.1			1,422.0	1,434.1	1,422.0	1,434.1	3,489.1	3,501.2	40.9
Missouri, Kansas & Texas	9.4				9.4	9.4	9.5				9.5	9.5	18.9	18.9	1,608.8	1,663.0	1.1
Missouri, Kansas & Texas of Texas	92.0	8.8			100.8	109.0							100.8	109.0	1,623.0	1,642.8	6.6
Missouri Pacific	59.6	38.9			98.5	137.0	3,527.5	19.6			3,547.2	3,566.8	3,645.8	3,703.8	3,698.7	3,770.6	98.2
St. Louis, Iron Mountain & Southern	113.8	13.2			127.0	140.2	2,641.4	169.8			2,811.2	2,981.1	2,938.3	3,121.3	3,062.4	3,297.1	94.6
Mobile & Ohio	1.5	10.3			11.8	22.1	15.8				15.8	15.8	27.6	38.0	1,122.5	1,132.9	3.3
Monongahela	.5	2.0			2.5	4.5							2.5	4.5	65.7	67.7	6.7
Munising, Marquette & Southeastern							3.7				3.7	3.7	3.7	3.7	123.8	123.8	2.9
Nashville, Chattanooga & St. Louis							72.0	38.6			110.6	149.2	110.6	149.2	1,230.1	1,268.6	11.7
Nashville Terminals		1.8			1.8	3.7	4.0				4.0	4.0	5.8	7.7	93.1	100.5	7.6
Newburgh & South Shore							.1	5.2			5.3	10.5	5.3	10.5	(1)	(1)	
New York & Long Branch		38.0			38.0	76.0							38.0	76.0	38.0	76.0	100.0
New York Central Lines:																	
Boston & Albany	2.6	128.0	56.4	24.9	211.9	527.4		.2	0.4		.6	1.6	212.5	529.0	357.0	676.0	78.2
Chicago, Indiana & Southern		5.0			5.0	10.0	238.9	59.1			298.0	357.1	303.0	367.1	303.0	367.1	100.0
Cincinnati Northern							202.8				202.8	202.8	202.8	202.8	202.8	202.8	100.0
Cleveland, Cincinnati, Chicago & St. Louis	23.9	98.5			122.4	220.9	569.2	274.7			843.9	1,118.6	966.3	1,339.5	1,878.2	2,266.4	59.1
Lake Erie & Western	48.0	8.8			56.8	65.7	814.7	.1			814.9	815.1	871.8	880.8	837.7	846.7	100.0
Lake Shore & Michigan Southern	27.9	210.8	99.4	267.1	605.2	1,816.1	994.9	1.3			996.2	997.5	1,601.4	2,813.6	1,607.8	2,820.7	99.7
Dunkirk, Allegheny Valley & Pittsburgh							90.5				90.5	90.5	90.5	90.5	90.5	90.5	100.0
Lake Erie & Pittsburgh							27.8				27.8	27.8	27.8	27.8	27.8	27.8	100.0
Michigan Central		271.9			271.9	543.8	871.6	19.3			890.9	910.2	1,162.8	1,454.0	1,162.8	1,454.0	100.0
New York Central & Hudson River	1.9	452.5		276.9	731.3	2,024.3	1,664.8	555.1	15.4		2,235.3	2,821.4	2,966.7	4,845.7	2,983.3	4,879.5	99.3
Peoria & Eastern							85.7	1.7			87.4	89.1	87.4	89.1	337.9	340.3	23.2
Pittsburgh & Lake Erie		107.8	1.6	49.3	158.7	417.6	2.7				2.7	2.7	161.4	420.3	166.0	427.0	98.4
Toledo & Ohio Central	2.1	4.2			6.3	10.5	126.7				126.7	126.7	133.0	137.2	390.7	397.4	34.6
Zanesville & Western	.8				.8	.8							.8	.8	65.8	65.8	1.2
New York, Chicago & St. Louis	146.3	12.2			158.5	170.7							158.5	170.7	512.5	603.3	28.2
New York, New Haven & Hartford	1.6	283.9		60.7	346.2	830.6	1,032.4	353.4		32.8	1,418.6	1,870.4	1,761.7	2,701.0	1,887.5	2,881.1	93.7
New York, Ontario & Western	48.3	149.4			197.7	303.7							197.7	303.7	513.7	667.7	45.5
New York, Philadelphia & Norfolk		8.7			8.7	17.5	40.0	63.2			103.2	166.4	112.0	183.9	112.0	183.9	100.0
New York, Westchester & Boston		11.2		6.8	18.0	49.7							18.0	49.7	18.0	49.7	100.0
Nevada Northern	1.2				1.2	1.2							1.2	1.2	140.3	140.3	.8
Norfolk & Western	98.7	486.9			585.6	1,072.5	1,001.5	24.6			1,026.1	1,050.7	1,611.7	2,123.2	1,725.9	2,237.4	94.9
Northern Pacific	684.0	500.3			1,184.3	1,688.4	276.5	61.0			337.5	398.2	1,521.8	2,086.6	5,655.0	6,308.6	33.0
Northwestern Pacific	11.1	15.5			26.6	42.1							26.6	42.1	406.5	420.9	10.0
Oakland, Antioch & Eastern	82.1				82.1	82.1							82.1	82.1	98.7	98.7	83.2
Ohio Electric	4.8				4.8	4.8							4.8	4.8	552.3	552.3	.9
Ohio Valley Electric							11.1				11.1	11.1	11.1	11.1	22.1	29.7	37.3
Pacific Electric		11.5			11.5	23.0	17.7				17.7	17.7	29.2	40.7	594.9	1,043.2	3.9
Panama	40.2	7.2			47.5	54.7							47.5	54.7	54.5	61.4	89.3
Pennsylvania		103.4	8.5	388.6	500.5	1,792.8	2,326.1	810.4	22.1	11.4	3,170.0	4,080.6	3,670.5	5,873.4	3,670.5	5,873.4	100.0
Cherry Tree & Dixonville							31.1				31.1	31.1	31.1	31.1	26.7	26.7	100.0
Grand Rapids & Indiana							224.6	2.0			226.6	228.6	226.6	228.6	544.7	557.3	41.0
Pennsylvania Co.		433.6	27.7	66.3	527.6	1,215.3	809.6	189.7	3.0	12.0	1,014.3	1,246.2	1,541.9	2,461.5	1,645.4	2,569.3	95.8
Pennsylvania Terminal							1.7	1.2			2.9	4.0	2.9	4.0	2.9	4.0	100.0
Philadelphia, Baltimore & Washington		73.0	22.6	39.2	134.8	370.6	427.8	78.8		1.9	508.5	593.0	643.3	963.6	643.3	963.6	100.0
Pittsburgh, Cincinnati, Chicago & St. Louis		33.5	2.7	3.5	39.7	89.0	727.3	527.7	57.4	26.2	1,338.6	2,059.6	1,378.3	2,148.6	1,412.9	2,200.8	97.7
West Jersey & Seashore		88.8	6.3		95.1	196.5	185.5	35.5			221.0	256.5	316.1	453.0	316.1	453.0	100.0
Vandalia	6.0				6.0	6.0	303.2	60.9			364.1	425.0	370.1	431.0	781.8	842.7	51.0
Peoria & Pekin Union	.8				.8	.8		6.1			6.1	12.2	6.9	13.0	16.0	24.8	52.4
Pere Marquette	108.8	7.6			116.4	124.0							116.4	124.0	1,628.9	1,687.4	7.3
Philadelphia & Reading	26.1	358.7	25.6	41.4	451.9	986.2	146.4	62.9			209.3	272.2	661.2	1,258.4	900.1	1,527.3	80.8
Atlantic City	1.1	86.7			87.8	174.5	36.0				36.0	36.0	123.9	210.6	166.3	254.2	82.8
Gettysburg & Harrisburg							24.2				24.2	24.2	24.2	24.2	31.0	31.0	78.0
North East Pennsylvania	7.3	2.0			9.3	11.3	1.6				1.6	1.6	10.9	12.9	25.6	27.6	46.6
Perkiomen							38.2				38.2	38.2	38.2	38.2	38.2	38.2	100.0
Philadelphia, Newtown & New York	5.4	1.3	2.1		8.9	14.5	11.2				11.2	11.2	20.0	25.7	21.9	27.5	93.4
Reading & Columbia							34.9				34.9	34.9	34.9	34.9	53.4	53.4	65.4
Piedmont & Northern	.8	3.5			4.3	7.8	126.3				126.3	126.3	130.6	134.1	130.6	134.1	100.0
Pittsburg, Shawmut & Northern	1.5				1.5	1.5							1.5	1.5	294.6	294.6	.5
Portland Railway, Light & Power	20.6				20.6	20.6							20.6	20.6	75.6	81.5	25.2
Quincy, Omaha & Kansas City, and Iowa & St. Louis							295.5				295.5	295.5	295.5	295.5	295.5	295.5	100.0
Queen & Crescent Route:																	
Alabama & Vicksburg	78.5				78.5	78.5							78.5	78.5	139.3	139.3	56.4
Alabama Great Southern	267.9	.4			268.3	268.8							268.3	268.8	290.5	298.4	90.0
Cincinnati, New Orleans & Texas Pacific	212.4	119.2			331.6	450.8	3.8				3.8	3.8	335.4	454.6	335.4	454.6	100.0
New Orleans & Northeastern	97.7	15.5			113.2	128.7							113.2	128.7	195.6	211.1	60.9
Richmond, Fredericksburg & Potomac		19.1			19.1	38.2	10.0	58.6			68.6	127.2	87.7	165.4	87.7	165.4	100.0
Rochester, Syracuse & Eastern	14.0				14.0	14.0							14.0	14.0	72.9	145.8	9.6
St. Louis & San Francisco	698.4	34.1			732.4	766.5	10.6				10.6	10.6	743.0	777.1	5,227.1	5,304.4	14.6
Beaumont, Sour Lake & Western							82.6				82.6	82.6	82.6	82.6	82.6	82.6	100.0
Orange & Northwestern							61.6				61.6	61.6	61.6	61.6	61.6	61.6	100.0
St. Louis, Brownsville & Mexico							480.7				480.7	480.7	480.7	480.7	526.6	526.6	91.2
St. Louis Merchants Bridge Terminal		5.9			5.9	11.8		1.1			1.1	2.2	7.0	14.0	9.9	19.8	70.9
St. Louis Southwestern	.4				.4	.4							.4	.4	686.8	702.0	
Southern Illinois & Missouri Bridge		4.6			4.6	9.3							4.6	9.3	4.6	9.3	100.0
San Francisco-Oakland Terminal		3.8			3.8	7.6							3.8	7.6	21.8	35.9	21.4
San Pedro, Los Angeles & Salt Lake	3.7				3.7	3.7							3.7	3.7	1,131.8	1,131.8	.3
Seaboard Air Line							303.4	9.6			313.0	322.6	313.0	322.6	2,827.6	2,837.2	11.4
Southern	6.3	245.8			252.1	498.0	1,688.7	116.0			1,804.7	1,920.7	2,056.8	2,418.7	6,928.9	7,436.6	32.5
Virginia & Southwestern							1.9				1.9	1.9	1.9	1.9	203.0	203.0	.9

[1] Freight Line.

MILEAGE OF RAILWAYS OPERATED UNDER THE BLOCK SYSTEM, JANUARY 1, 1915—CONTINUED

Names of railroads.	Automatic block signals.						Nonautomatic block signals.						Total automatic and nonautomatic.		Total passenger lines operated.		Per centage block signaled, miles of track.
	Single track.	Double track.	Three track.	Four track.	Total. Miles of road.	Total. Miles of track.	Single track.	Double track.	Three track.	Four track.	Total. Miles of road.	Total. Miles of track.	Miles of road.	Miles of track.	Miles of road.	Miles of track.	
Southern Pacific—Sunset-Central Lines:																	
Galveston, Harrisburg & San Antonio	279.5				279.5	279.5	1,233.7				1,233.7	1,233.7	1,513.2	1,513.2	1,235.7	1,241.5	99.7
Houston & Shreveport							39.8				39.8	39.8	39.8	39.8	39.8	39.8	100.0
Houston & Texas Central	2.9				2.9	2.9	814.5				814.5	814.5	817.4	817.4	749.9	751.2	99.8
Houston, East & West Texas	2.7				2.7	2.7	188.2				188.2	188.2	190.9	190.9	190.9	190.9	100.0
Lake Charles & Northern							44.3				44.3	44.3	44.3	44.3	44.3	44.3	100.0
Louisiana Western	103.6				103.6	103.6	198.3				198.3	198.3	301.9	301.9	140.3	140.3	100.0
Morgan's Louisiana & Texas	95.3				95.3	95.3	239.1	40.2			279.3	319.5	374.6	414.8	242.4	279.7	91.1
Texas & New Orleans	111.4				111.4	111.4	397.7				397.7	397.7	509.1	509.1	407.5	411.0	100.0
Southern Pacific—Pacific System	2,385.8	408.6	3.1	2.5	2,800.0	3,222.3	3,526.0	10.8			3,536.8	3,547.6	6,336.8	6,769.9	6,336.8	6,769.9	100.0
Spokane, Portland & Seattle	.5	6.8			7.3	14.1							7.3	14.1	540.0	550.0	2.5
Oregon Electric	1.0	6.9			7.9	14.8							7.9	14.8	7.9	14.8	100.0
Spokane & Inland Empire	.2				.2	.2							.2	.2	168.3	187.3	.1
United Railways	1.1				1.1	1.1							1.1	1.1	27.8	27.8	3.9
Syracuse, Lake Shore & Northern	16.7	5.9			22.6	28.5							22.6	28.5	32.3	47.1	60.5
Terminal Railroad Association of St. Louis		6.0			6.0	12.0		1.1			1.1	2.2	7.1	14.2	12.7	25.4	56.0
Terre Haute, Indianapolis & Eastern Traction	47.6				47.6	47.6							47.6	47.6	366.1	366.1	13.0
Texas & Pacific	1.0				1.0	1.0							1.0	1.0	1,879.8	1,879.8	
Tidewater Power Co.							6.2				6.2	6.2	6.2	6.2	11.3	15.7	39.5
Toledo, Peoria & Western							.6				.6	.6	.6	.6	230.7	230.7	.2
Toledo, St. Louis & Western							188.1				188.1	188.1	188.1	188.1	451.0	451.0	41.7
Ulster & Delaware	24.1				24.1	24.1							24.1	24.1	129.6	129.6	18.1
Union (Pa.)		.6			.6	1.2	1.4				1.4	1.4	2.0	2.6	7.4	14.8	17.6
Union Pacific	652.7	817.9		1.7	1,472.4	2,293.2	10.9				10.9	10.9	1,483.3	2,304.1	3,588.2	4,423.8	52.1
Oregon Short Line	519.9	106.9			626.8	733.7							626.8	733.7	1,742.6	1,849.5	39.6
Oregon-Washington Railroad & Navigation	603.4	26.8			630.2	657.0	1.3				1.3	1.3	631.5	658.3	1,799.6	1,829.8	35.8
Union Traction Company of Indiana	49.9				49.9	49.9							49.9	49.9	362.7	371.6	13.4
Virginia & Kentucky							.6				.6	.6	.6	.6	4.8	4.8	12.5
Virginian							13.2				13.2	13.2	13.2	13.2	470.0	470.0	2.8
Wabash	9.7	100.5			110.2	207.5	1,520.1	239.8			1,759.9	1,999.7	1,870.1	2,207.2	1,978.6	2,345.4	94.1
Wabash-Pittsburgh Terminal		4.1			4.1	8.2							4.1	8.2	63.3	67.4	12.2
Washington, Baltimore & Annapolis	13.8				13.8	13.8							13.8	13.8	52.2	84.3	16.4
Washington Southern		4.1		1.5	5.6	14.2		26.5			26.5	53.1	32.1	67.3	32.1	67.3	100.0
Washington Terminal		1.1		1.0	2.1	20.4							2.1	20.4	2.1	20.4	100.0
Washington Water Power Co.	22.5				22.5	22.5							22.5	22.5	22.5	22.5	100.0
Western Pacific	11.2				11.2	11.2							11.2	11.2	11.2	11.2	100.0
Western Maryland	62.0				62.0	62.0							62.0	62.0	662.7	735.0	8.4
Total	13,763.9	14,262.6	412.4	1,424.6	29,863.5	49,442.1	59,271.5	7,152.6	226.0	95.0	66,745.1	74,672.9	96,608.6	124,115.0	193,180.2	223,081.3	

tensive adoption of the manual block system on the Southern Pacific, as here noted, is now published for the first time.

It will be noted that the number of roads reporting block signal mileage for the first time is quite large; and in addition to those which appear in this table, the larger table shows also the following: Eastern of Kentucky; Huntingdon & Broad Top Mountain; Kansas City Terminal; Mineral Range; Nevada Northern; Pittsburgh, Shawmut & Northern, and a number of electric roads.

The cases of the New Haven and the Southern Pacific, just mentioned, are not the only ones in which there is a discrepancy between the data given to the *Railway Age Gazette* and that given to the government. As in former years, the time which elapsed between the sending of reports to the *Railway Age Gazette*, about December 1, and that when the statistics were sent to the government, about January 15, seems to have produced both increases and decreases. The following six roads reported a mileage to the government smaller than to us by the differences shown, the *Gazette* figures being shown first and the government figures following. Central New England, 264—71; Central of Georgia, 73—55; Chicago & North Western, 3,725—3,598; Ft. Dodge, Des Moines & Southern, 120—16; Michigan Central, 1,306—1,163; Southern, 2,378—2,057.

The following three, in addition to the two named above, show increases: Chesapeake & Ohio, 2,008—2,083; Chicago, Milwaukee & St. Paul, 4,386—4,717; St. Louis & San Francisco subsidiaries, 0—625. Many smaller roads show slight differences. The following roads, reported by us, do not appear in the government table: Florence & Cripple Creek, five miles; Rock Island Southern, 80 miles; South Dakota Central, 103 miles.

In the reproduction of Table No. 1, a number of explanatory notes have been omitted, the information contained in them being mainly a repetition of what has been published in former years.

No less than 686 miles of road operated by the manual block system is reported as equipped also with automatic signals, which are not reported in the table of automatic mileage. The roads reporting this apparent duplication are the Atchison, Topeka & Santa Fe; Baltimore & Ohio; Louisville & Nashville; Pittsburgh, Cincinnati, Chicago & St. Louis; Southern Pacific; Wabash.

Table No. 2 shows a decrease in the miles of road equipped with exposed disk signals of 53 miles; and of 68 miles in enclosed disks. On the Reading there is an increase in the item of enclosed disks, of about 38 miles of road, but on the two other roads which make extensive use of these signals—the Chicago & North Western and the Lehigh Valley—there are considerable decreases. The total of miles of road equipped with electro gas signals is 891, an increase of 372 miles which, however, appears to be due to errors in last year's statement. The Delaware & Hudson reports 318 miles of road using these signals, and the Atchison, Topeka & Santa Fe 78 miles.

The mileage of automatic block signals not classified is 353 miles. This represents mostly electric railways.

Tables 3, 4 and 5 give further details concerning methods and apparatus used with the manual block system, styles of automatic signals, data concerning alternating current, etc., and colors of night indications, all tabulated in the same shape as in the last preceding bulletin. Telephones are used in manual block signaling on 28,364 miles of road, or 2,122 miles more than on January 1, 1914.

Tables 6 and 7 give the number, types and characteristics of interlocking plants, with a variety of information concerning details of design and of practice. As heretofore, these tables appear without totals for the whole country, for the reason that a considerable number of interlocking plants are reported each by two or more different roads.

Telephones are used for the transmission of train orders on 93,467 miles of road, or 16,175 miles more than on January 1, 1914.

RUSSIAN RAILWAY AFFAIRS.—The Ministry of Ways of Communication has agreed to the need for widening the Archangel Railway next autumn to full gage.

Maintenance of Way Section

Officers in the maintenance of way department are familiar with the marked change in the personnel of their employees and also in the attitude of the men towards the companies during recent years. The primary reason for this, the continually increasing difference between the wages of organized and unorganized employees, is pointed out in another column. This problem is a difficult one for the railway managers to solve. Every one will admit that the present practice of increasing wages only where the companies are unable to resist the demands of the employees is a short-sighted one, but no manager has yet had the temerity to raise the wages of unorganized employees to the same basis as those for organized labor in the face of decreasing net revenues. Under present conditions the maintenance of way department employees, who are unorganized, suffer in comparison with those of the mechanical and transportation departments, who are very largely organized. This condition cannot continue indefinitely, and its results are distinctly evident today in the rapidly decreasing efficiency of the men in the former department and in the absence of the loyalty so marked among trackmen a couple of decades ago. It will take courage to meet this issue fairly, but it must be met in the near future, and temporizing with it only increases its difficulty.

The Wage Differential

The ballast best adapted to the needs of a particular railway may be of one material, while that most economical may be of an entirely different character. In other words, the kind of ballast it may be most practical to use depends upon the traffic, topographic and climatic conditions of the track to be ballasted, and also on the kind of material available. There is some particular kind and source of ballast most economical for any particular location. One sees material hauled long distances because of its excellent quality, the long haul making it unduly expensive by the time it is placed in the track. On the other hand, one also sees inferior ballast placed in the track when a better quality can be secured with a slightly longer haul. He also sees one road covering stone ballast with gravel and other placing stone on top of gravel. Between these extremes there is a mean. This prompts the suggestion that on a system of any magnitude a careful survey of ballast conditions can well be made, showing all the available sources of supply, and the relative merits of the different kinds for local purposes. From such a survey the most economical sources of supply can be determined, as well as the limits between which the material from any particular source should be secured. A survey will show the extent to which present practice based on general estimates is sound or unsound. Of course, in some localities there is little choice as to the material to be used, but on most roads this is not the case.

The Selection of a Ballast Supply

The merits of engine cinders as ballast material are not sufficiently realized on many roads. With the exception of those burning oil in the southwestern and western states, almost every railroad produces large quantities of cinders. Too often they are considered a cause of necessary expense and are wasted or used only for filling. While their quality varies with the character of the fuel burned, in most cases they make excellent ballast for branch lines, or even for freight lines of relatively heavy traffic. They provide excellent drainage and are easily worked, while in many parts of the country they have relatively long life. Because of their relative cheapness, they can frequently be used to improve the condition of branch lines where heavy expenditures might not be justified. Their use should be more seriously considered in connection with other ballast materials.

The Merits of Cinders as Ballast

A roadmaster in a northern state was overheard taking a section foreman to task because one of the track laborers was observed to rest his elbow on his knee in lifting his tamping pick. The roadmaster closed his remarks by stating that no man who followed that practice could work on his district. If he should travel through the South he would see many colored track gangs at work, not one, but all of whose members would be observed to be doing the same thing. It is not our intention to discuss the merits of this or any other method of handling a tamping pick, but simply to call attention to the fact that motion study has never been seriously undertaken in connection with track work. Surely there could be no more simple or practical matter to which such study could be applied. References to the proportion of railway revenues expended for track labor have been made too often in these columns to require repetition. A proper study of this subject would involve a relatively insignificant outlay. The objection that the class of track laborers now available is not sufficiently good to offer an inviting field for such study, is answered by the fact that some of the earliest and most successful experiments in motion study related to the very simple tasks of lifting and carrying pig iron. Observations of track work in various parts of the country disclose wide differences in the methods used in doing the same tasks. While it is impossible to say that the method used at one place is correct, and that used at another wrong, there are certain to be material differences found in the efficiency of the several methods investigated. An effort to determine which is the best deserves serious consideration.

Motion Study in Track Work

In the conference on valuation held in Washington a few weeks ago, Director Prouty of the department of valuation of the Interstate Commerce Commission asked how deferred maintenance could be determined and whether, comparing one road with a high standard of maintenance and another with a low standard, the one with the low standard should be considered to have deferred maintenance. For instance, one road may paint its stations at intervals of four years and another every six years. Would a union station at a junction point be maintained to the proper standard if it had not been painted for five years? This at once raises the question of how a standard of maintenance is determined. Every road must decide on the standards to which it will keep up its property. A road with a large proportion of heavy freight traffic is not justified in maintaining its tracks to as high standards as one with an equal traffic consisting largely of fast passenger trains. Likewise, track which will ride well at 40 miles an hour may not ride so well at 60 miles an hour. Maintenance of way expenditures are of two kinds, those which make for ultimate economy, such as the use of treated ties, and those necessary for the normal upkeep of the property. It is with the latter class that we are most directly concerned here. It is unfortunately, but necessarily, true that the basic factor governing the standards of maintenance on many roads is the amount of money they can afford to spend. However, on the average

Standards of Maintenance

road and during average years money is available for necessary and prudent expenditures. To make these expenditures most economically, those in charge must necessarily determine the standards justified by the traffic not only for the system as a whole but for each subdivision separately. The economy attending this distribution will depend upon the closeness of this determination. From this it can be seen that the answer to Director Prouty's question depends entirely upon local conditions and can only be answered in the light of a definite statement of facts for each particular location.

The Problems of the Supervisor of Bridges

The problems confronting the master carpenter or supervisor of bridges and buildings on the average road differ widely from those confronting the supervisor of track. The duties to be performed are of greater variety, and the difficulty of adequately supervising the gangs is greater. On most roads the bridge supervisor is responsible first for the maintenance and repair of the bridges on his territory. He must give his personal attention to their inspection at regular intervals and direct the work of the bridge carpenters, concrete gangs, pile driver crews and other forces engaged in the renewal or replacement of all but the larger structures. The supervisor of bridges and buildings is also in charge of building repairs, including stations, shops, coal chutes and other buildings on his territory. He has charge of their painting at regular intervals, as well as the painting of bridges, roadway signs, etc. Another important branch of his work is the water service. Usually he is not only in charge of the installation and maintenance of water stations, including the pumps, pipe lines and tanks, but of their operation as well, and the pumpers are carried on his time roll. In short, he is usually in charge of all maintenance other than that of track and signals. The supervisor of bridges usually has a considerably greater mileage than the supervisor of track, his territory frequently coinciding with that of the division superintendent. His gangs are scattered over the division, handling the various specialized problems and frequently moving rapidly from one small job to another, so that under the most favorable conditions a large portion of the time of the employees of this department is necessarily lost in traveling from one place to another. The wide variety of work, requiring men of different experience and skill, and provided with different kinds of tools, combined with the large mileage of line covered, make the securing of economical results in this department very difficult. Furthermore, this scattering of forces makes adequate supervision almost impossible. On some of the more intensively developed roads in the east these conditions have been greatly improved by subdividing the work and reducing the units of supervision. It is entirely possible that this plan can be followed to good advantage on the more important divisions on other roads, subdividing the work either by territorial lines or concentrating certain classes of work over the entire division, as, for instance, water service, with certain gangs. The most practical means of securing more satisfactory results under existing conditions is receiving serious attention on a number of roads.

THE LABOR PROBLEM

SINCE the beginning of railway operation maintenance of way work has been done almost entirely by company forces paid at a flat rate. This is strong circumstantial evidence that such a practice is the best. It is not, however, conclusive. Changed conditions require revised methods in all industries. No one will disagree with the statement that the character of the labor employed in the maintenance of way department has deteriorated within recent years, and the end does not appear to have yet been reached.

The experiment of the Michigan Central in placing ballast under its main tracks by contract, is one attempt to deal with present unfavorable labor conditions. Such a practice would be pronounced impracticable by many if it had not been worked out successfully on this road during the past six years. While contract work in a way, this plan of the Michigan Central in its mode of application is essentially a piecework system. The railroad furnishes the ballast unloaded along the track and the contractor places it at certain fixed unit prices. The company, therefore, provides the material and the contractor assumes the responsibility for the organization and handling of the labor. The incentive of personal gain is one of the strongest that influences mankind. In a large organization, such as that of a railroad, the feeling of personal responsibility for results is not developed as fully as in smaller organizations and many men become mere cogs in a machine. Under the Michigan Central plan the contractor secures directly for himself the benefit of the savings made by any increase in the efficiency of his men. He therefore has a personal interest in accomplishing the maximum amount of work and will put forth greater efforts than the average section or floating gang foreman. He will not only try to secure greater results from his men on the work, but he will naturally select his forces with more care and with more consideration of their qualifications for the work in hand.

He is also free from many of the regulations about rates of pay, etc., governing railway work. By securing reasonably low unit prices in the contract the railroad shares with the contractor in his savings, while the standards of work are maintained by proper inspection. Such a plan is not necessarily limited to ballast work, but is equally applicable to much of the other work commonly done. As with any experiment, great care must be exercised in the selection of the contractor and his foremen to get men who are familiar with the work and who will exercise the necessary precautions for the safe conduct of traffic. In this instance, former employees of the road who were known to be capable were given the contracts.

The method used by the Michigan Central is but one of many that may be employed to create an increased interest and sense of responsibility among track employees. Another road has given careful consideration to a plan whereby certain section foremen will be given definite allowances for labor from month to month and then be permitted to hire their own men and to conduct their work as they believe best, subject to suitable supervision. Any savings made out of their allowances go to the foreman, the idea being to cultivate in these men a sense of proprietorship in their sections whereby they will exercise the same care in the expenditure of the company's money as they would exercise in the spending of their own.

Another eastern road made careful time studies from which it determined the present and possible average unit costs of various items of track work. Standards were then placed before the laborers as well as the foremen and the company divided the savings resulting from the increased output with the men. Although this plan was only in effect a few months, the unit performances increased steadily.

We have given much space in these columns to these and similar developments of methods of increasing the efficiency of the labor in the maintenance of way department, as we believe that herein lies the greatest opportunity for economy in this department. Almost 60 per cent of all expenditures for maintenance of way and structures are for labor, as compared with 40 per cent for materials, in which, from their very nature, only relatively small savings can be made. The expenditures for labor offer a very promising field for careful study. All of the developments to which we have referred may be considered to still be in the experimental stage, and while perhaps the methods used may not be practicable for universal or even wide application in their present form, they may be capable of modification to meet varying conditions. The results to be secured warrant sympathetic and careful study.

NEW BOOKS

Proceedings of the American Wood Preservers' Association. Size 6 in. by 9 in., 527 pages, illustrated. Bound in cloth. Published by the American Wood Preservers' Association, F. J. Angier, secretary-treasurer, Mount Royal Station, Baltimore, Md. Price: cloth, $3.50; paper, $2.50.

The eleventh annual convention of the American Wood Preservers' Association was held in Chicago, January 19-21, 1915. This volume contains the complete proceedings of that convention, which was one of the best in the history of the association. A valuable feature of this book is the statistical information relative to the quantity of wood preservatives consumed and the amount of wood treated in the United States in 1914 and a list of the timber treating plants in operation with data concerning each. There is also published a list of almost 400 United States patents relating to wood preservation.

The Railroad Taper. By Lee Perkins, formerly assistant engineer, Southern Pacific Lines in Arizona and Mexico. Size 4 in. by 6¾ in., 355 pages, 41 figures, 42 tables. Published by John Wiley & Sons, Incorporated, New York City. Price $2.50.

This handbook contains an extension and elaboration of a transition curve devised a number of years ago by William Hood, chief engineer, Southern Pacific, and used extensively on those lines. This transition curve is theoretically a series of compound curves with 30 ft. chords and the tables are prepared so that it may be run with one setting of a transit. All the functions for both field and office work are given for 11 different easements of increasing increment, although three will meet almost all ordinary demands except in mountainous country. The spiraling of old curves is treated separately from that on new work. The discussion of the theory underlying this spiral is followed by the usual complete series of tables.

American Railway Engineering Association Proceedings. Size 6 in. by 9 in., 1,562 pages, illustrated. Published by the American Railway Engineering Association, E. H. Fritch, secretary, 900 S. Michigan avenue, Chicago. Price: paper, $6; cloth, $6.50; half morocco, $7.

This volume contains the complete reports presented before the sixteenth annual convention held in Chicago, March 16-18, 1915, with discussions. It also contains 11 monographs previously published in bulletin form during the year by the association. These proceedings are so well known among railway men that little description is necessary. They form a valuable and necessary part of the library of every railway officer concerned with construction and maintenance of way problems. The book is the same size as that of last year and is printed on thin paper in order that it may be bound in one volume.

Tunneling. By Eugene Lauchli. Size 6 in. by 9 in., 238 pages, 197 illustrations. Bound in cloth. Published by the McGraw-Hill Book Company, New York City. Price $3.

The very rapid and important development that has taken place in tunneling methods and machinery in recent years is in itself a sufficient justification for a new treatment of this subject, and the author has kept in mind the needs of the engineer in discussing these improvements. The book avoids long detailed descriptions of individual tunnel projects and arranges the discussions under the natural divisions of the work of driving and lining a tunnel. In developing the theoretical portions and in the discussion of current practice, however, frequent references to individual tunnels are included. The size of the book precludes a detailed treatment of numerous allied subjects, such as drilling machinery, compressor and ventilating plants and explosives, but ordinarily data on these subjects is readily available elsewhere. Of course, however, in discussing new methods of driving tunnels and of lining them, it is necessary to refer to and to some extent to describe the new types of machinery which have made the new methods of work possible.

Letters to the Editor

THE RISING WAGE DIFFERENTIAL AND THE CURE

CHICAGO, Ill.

TO THE EDITOR OF THE RAILWAY AGE GAZETTE:

As a preface to what follows in this article the writer desires to state that he is not opposed to high wages, nor does he attack as a principle the right of employees to organize in just efforts for their protection and the improvement of conditions. Organization of a few branches of the service, however, has militated against the best interests of those departments which have not organized and which will not or are not in a position to identify themselves with protective affiliations.

In the early days of railroading and other industries in this country there was present a keener sense of loyalty and respect than prevails today, and this fact can be explained by an inspection of the relative treatment accorded to the organized and unorganized branches of the service. As in the case of an individual, no group or large body of men will have either respect or loyal feelings for an employer from whom they extract increases in pay or improved conditions as a result of concerted action of their own whether it be by political influence or sheer force of numbers. This explains the attitude of that group included in the large brotherhoods of this country and an appreciation of this fact will clear the way for an understanding of the reason why the unorganized branches are beginning to lose the old-fashioned sense of loyalty for the respective managements under which they labor.

The enforced recognition of the brotherhoods has worked untold harm on the unorganized branches in that the wages of the former have been boosted so high that the amount or relative importance of the work done is not a factor in determining the rates paid. Thus has come a strange and unnatural relation which may be termed the rising differential.

As successive and successful demands for increases have been made by the brotherhoods, the ratio representing the wages paid to them and to the unorganized branches has steadily risen and the difficulty of securing and retaining the right sort of men has proportionately increased. Loyalty thrives on only one thing —just treatment for all hands. This slogan has been absent from railroad wage adjustments for many years.

The railroads of this country have been very short-sighted in their method of handling wage matters. By ignoring costs of living and by deferring normal increases in pay until forced to make unjust distribution to a few favored departments, they have automatically placed a premium on organization and almost entirely killed that great feeling of loyalty that once existed. Though "almost" killed, there is still left of loyalty a small spark and it can be nourished and warmed into something substantial if steps are taken in time. In the writer's opinion the only cure lies in the establishment of a fixed policy on the part of the railroad managements to the effect that no increases will in future be made to any branch or department individually.

In other words, every increase must be a flat per cent increase on the wages paid to each and every one in the service. Such a policy as this would give to the railroads the greatest bulwark they could possibly secure, as it would make for ultimate peace. If the organized branches were to attack this principle, they would at once forfeit the sustaining power of public opinion, as the utter selfishness of such action would stand forth unmasked. The rising differential is a fact and is a monstrosity born of cupidity and cowardice; cupidity on the part of the organized branches through their clearly defined policy of looking only to their own interests, and cowardice on the part of the railroad managements which should have fought the issue years ago. The fight must be fought some day and the longer deferred, the harder will the contest be.

DIVISION ENGINEER.

The Stripping of Gravel Pits by Hydraulic Methods

An Outline of the Conditions Under Which this Practice is Economical and the Manner of Handling the Work

By W. H. Wilms

Manager, Universal Sand and Gravel Company, Brooklyn, Ind.

During the past ten years there has been a rapid increase in the use of the hydraulic method of earth removal. Engineers are just beginning to appreciate the possibilities of this method of excavation, and the next decade will undoubtedly witness a still greater development and growth in hydraulic excavation. The filling of trestles on the Northern Pacific and the Canadian Pacific at a cost of from 4 to 13 cents per cubic yard; the removal of 34,000,000 yd. of material in the regrading of Seattle, Wash.; the hydraulic construction of large embankments on the Pacific coast extension of the Chicago, Milwaukee and St. Paul; and the more recent construction of the Fernando dam of the Los Angeles acqueduct, where about 2,000,000 yd. of earth were sluiced at a total cost of 7 cents per yard are recent examples. The remarkable results obtained in these cases seem to be little realized or appreciated by many engineers unacquainted with this class of work.

A comparatively large field for this method of earth excavation is in stripping the overburden of gravel ballast pits and stone quarries. Conditions about a gravel pit are quite often favorable to the hydraulic method of stripping. The soil is generally a loam or soft clay that can be handled very effectively with water. A great many gravel deposits are either very close to a stream or river or underlaid with water, an ample supply of water thus being assured. The sluiced material can also be dumped in many cases into the abandoned or worked-out portions of the pit. Where this is possible, ample dumping grounds and sufficient grades for the flumes are generally assured.

Very little if any information of value on the hydraulicking of earth exists in published form. What has been printed is generally of a very meager nature and incomplete in its details. What information of value does exist, relates to the hydraulicking of auriferous gravel which requires much greater quantities of water proportionately than loam or soft clay. The Seattle regrade work and the Chicago, Milwaukee and Puget Sound embankment work, previously mentioned, were gravel or glacial drift; in the former case the material consisted of about 65 per cent gravel and 35 per cent very hard clay, the clay being so hard that it was necessary to use powder to effect its removal by the water; in the latter case the sand and gravel content was equally high. The results of these undertakings, therefore, afford us no criterion as to what can be accomplished in the hydraulicking of ordinary earth, such as loam or soft clay.

The conditions necessary for hydraulicking are an abundant water supply; a material that can be effectively sluiced with water; a dumping ground for the sluiced material; and ample flume grades to the dump. Where all of these conditions are favorable, hydraulicking becomes the most efficient and economical method of earth removal known. However, if any one of these conditions is lacking or decidedly unfavorable, hydraulicking is almost sure to prove a failure. In considering an hydraulic installation, therefore, it is necessary to investigate thoroughly and completely, and to analyze the above conditions before deciding on this method of excavation. The depth of the overburden is also to be considered. If the stripping is shallow, not exceeding 3 ft. in depth, and a large daily output or yardage is desired, the hydraulic method should be adopted with a great deal of caution.

DUTY OF THE WATER AND SIZE OF INSTALLATION

The amount of water necessary to move one cubic yard of material depends upon the grade of the flumes, the character of the material and to a more or less extent upon the pressure of water available. The quantity of water is of more importance than the pressure. Comparatively light grades can be used for the flumes if a sufficient quantity of water is present to effect complete suspension. Clay requires more water, greater pressure and greater flume grades to handle than ordinary loam or dirt. The amount and size of rocks, if any, also effects appreciably the duty or carrying capacity of the water. It may be said, however, that as a minimum, with ordinary loam or soft clay and flume grades of 7 to 9 per cent, 10 cu. yd. of water are required to move 1 cu. yd. of material. As a basis for an estimate, however, it is generally not advisable to depend upon a greater percentage of spoil than 15 per cent for loam or dirt with the usual flume grades of 7 to 9 per cent. For soft clay and heavy, sticky loam, 10 to 12 per cent can be considered a safe estimate where 7 to 9 per cent grades can be obtained. The above duties are based upon a flow of 1,000 gal. per min., which is considered by the writer as the minimum discharge advisable for hydraulicking.

In stripping gravel deposits a considerable amount of water is lost by flowing down into the gravel, which must often be considered in estimating the necessary water supply. If the top strata of the gravel deposit is a sand or compact gravel this loss is generally insignificant, amounting to only 2 or 3 per cent. If, however, the top strata is a coarse, loose gravel, the loss from this source may be as high as 10 per cent.

A pressure of from 40 to 60 lb. per sq. in. at the nozzle is usually sufficient for the sluicing of loam or dirt. For soft clay and some heavy loams, 60 to 80 lb. pressure is usually required. A pump having a capacity less than 1,000 gal. per min. should not be installed. A 1,500-gal. discharge would be more efficient, and for the ordinary installation is to be preferred. With such a discharge, using two nozzles, and with favorable grades, it should be possible to sluice from 450 to 700 cu. yd. of material per day of 10 hours. A crew would ordinarily be required for such an installation consisting of one pumper or engineer; two pipemen; one assistant to the pipemen; three laborers and a foreman tearing down and erecting flumes; and one laborer on the dump.

FLUMES

The water supply, the character of the overburden and the fall available to the dump determine the grades of the flumes. In the stripping of gravel pits where the excavated space is used as a dumping ground, ample grades for the flumes are generally assured. Full advantage, however, should be taken of all the fall available, a difference of only 1 per cent in the grade of the flume effecting a great difference in the carrying capacity or duty of the water. Where the available fall makes necessary the use of low flume grades much larger quantities of water are required to effect complete suspension of the material. For stripping service grades lower than 6 per cent should not be used. Where 3 per cent and 4 per cent are the maximum that can be used, the quantity of water necessary for the operation of such low grades is so great that hydraulicking fails to show any great economy over other methods. While it is true that grades as low as 3 and 4 per cent are often used in large hydraulic mining operations, it should be remembered that in such operations the flume grades must be kept comparatively low, so that the velocity of the water will not be so great as to prevent the gold from settling in the riffles in the bottom of the flume. The object here is to use sufficient water to transport the gold bearing gravel and flume grades that will not cause excessive velocities. It is because of this fact that the carrying capacity of water in hydraulic mining is very low, the

material excavated amounting to only about 2 to 6 per cent of the water used.

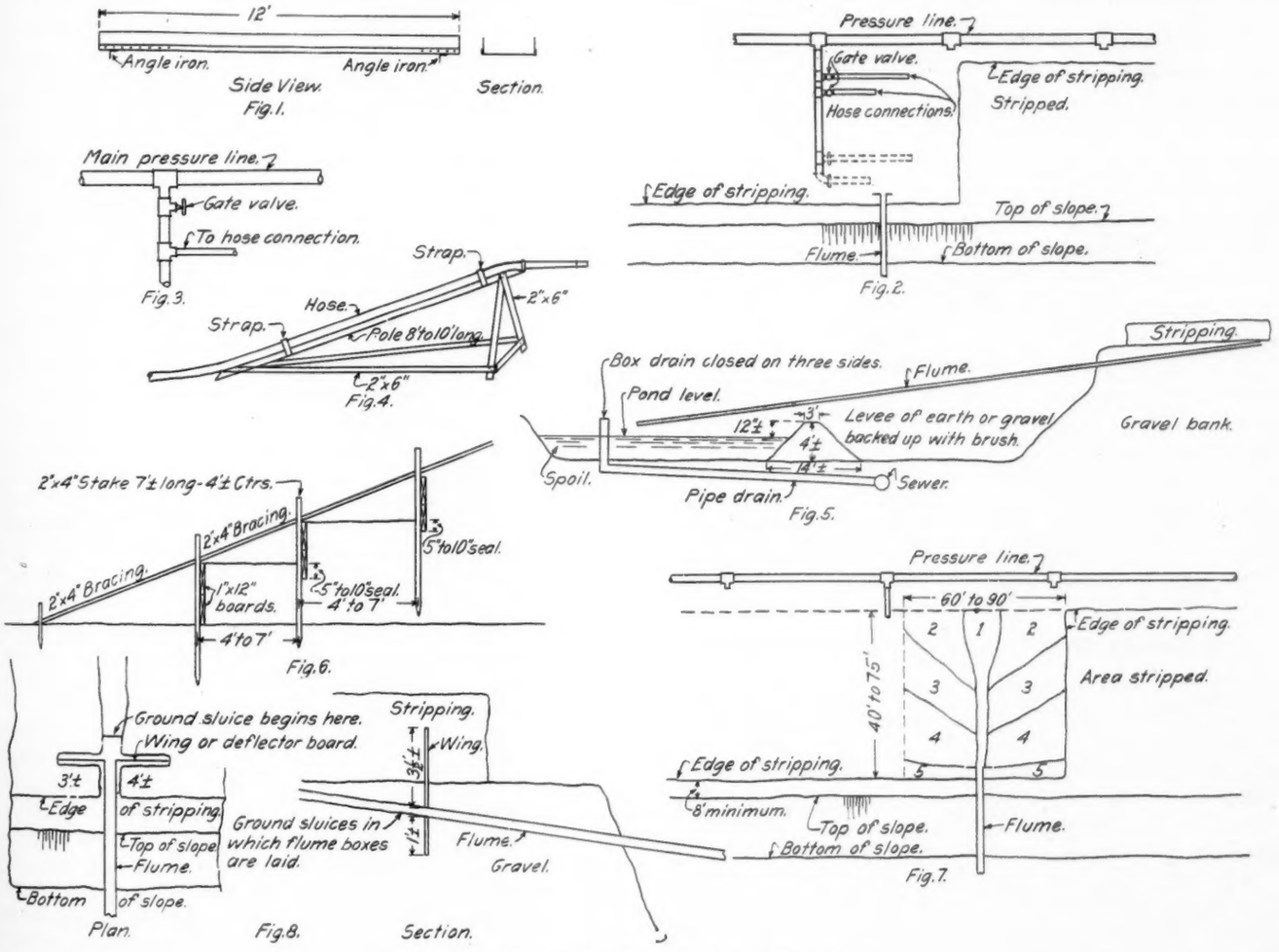
Where conditions will permit, the flume grade should be at least 7 per cent; 8 to 10 per cent grades with an abundant supply of water are considered very satisfactory grades, and are usually obtainable in stripping operations where the material is sluiced into the workedout portions of the pit. These remarks apply only to box flumes. Where ground sluices are used considerably heavier grades must be used, as they are very likely to become clogged up from roots, gravel, sticks and pieces of sod. In such cases the writer prefers to use flume boxes in these open sluices as shown in Fig. 8. The time required to place them will be but a fraction of that lost in continually cleaning out the open ditch.

Flume grades should be made as uniform as possible. A slight break in the grade will often cause clogging, especially if a sandy loam is being handled. Abrupt changes in the alinement of the flumes are best made by making a break or drop in the flume grade.

Sand requires heavy grades and shallow sluices. Wide, shallow sluices should be used where the grades are light. If the overburden contains many stones and boulders deep, narrow sluices should be used. In this case, the depth of the water in the flume should be equal to the width of the flume. The width and depth of flumes depends largely upon the character of the material as well as the water supply.

The rectangular section for flumes is generally to be preferred to the semi-circular or elliptical section. A large amount of the material carried by the water travels or rolls on the bottom of the flume. Where the circular section has been used the wear on the flume has been confined to a relatively small area in the lowest part of the section. Where stones or gritty material are present in the overburden this wear becomes excessive, the metal wearing through and becoming full of holes in a very short time. With the square or rectangular section, however, the wear is quite evenly distributed over the bottom, resulting in a much longer life of the flume.

In order that the flumes may be easily and quickly erected and taken down they should be built in sections or boxes from 10 to 12 ft. long. Both wooden and metal flumes are used. Wooden flume boxes have proven very unsatisfactory for stripping service, as they quickly become water soaked and heavy, and when dried out, check and split badly. Moreover, in the constant rehandling of the flume boxes, they go to pieces very soon. In stripping, flumes are changed many times and a flume box should be built that will not only stand the excessive wear



Flume Construction for the Stripping of Gravel Pits

and abrasion of the material being carried, but the rough and constant handling as well. For this service the metal flume is probably the best suited. Fig. 1 is a sketch of a steel box flume that has given very good service. This flume is constructed of No. 14 gage steel, and is made in sections 12 ft. long.

It sometimes becomes necessary to carry the sluiceway or flume through an intervening ridge to obtain a dumping ground for the sluiced material. If the tunnel has a heavy grade, vitrified sewer pipe will prove satisfactory. If the grade is light, however, any slight settlement of the pipe joints is liable to cause clogging. Under such conditions riveted steel pipe in lengths of 20 ft. or more has given very satisfactory results. Pipe of No. 16 to No. 14 gage steel has been used for this purpose.

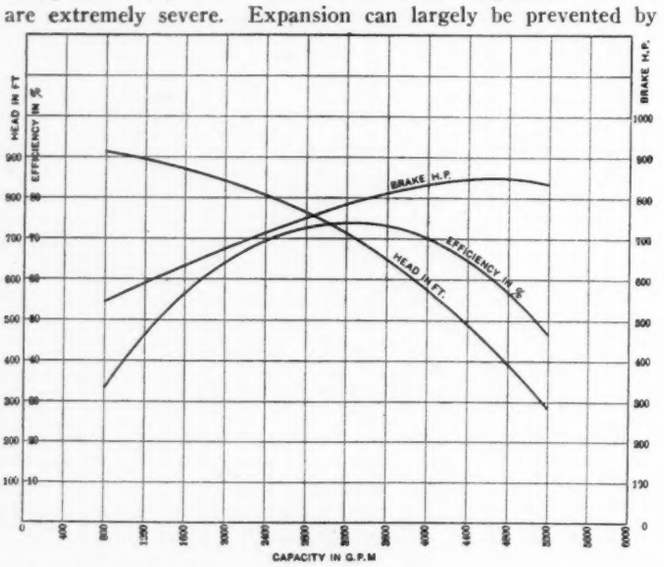
PIPE LINE

For diameters up to and including 10 in. standard lap welded

steel pipe is recommended for the pressure line, there being very little difference in the cost of this pipe and spiral riveted pressure pipe. Above 10 in., however, there is a decided difference in cost between the lap-welded and spiral pipe in favor of the latter. However, if the pipe is to be subject to frequent changes and rehandling, a very heavy grade of steel is necessary in spiral riveted pipe which may entirely wipe out this difference in cost. Owing to frequent rehandling, the asphaltic or tar covering of the spiral pipe, also suffers. Longitudinal riveted steel pipe is not usually obtainable in the sizes ordinarily required for hydraulic operations of moderate size, 20 in. being about the minimum diameter obtainable.

On account of the frequent shifting and changing of pipe a large number of flanged joints in the pressure line are desirable. Standard companion flanges and not flange unions are preferable.

All abrupt angles and changes in the pipe line should be securely anchored, as the water hammer and expansion stresses are extremely severe. Expansion can largely be prevented by



Curves Showing Characteristic of Worthington Turbine Pump

providing one or two gate valves and keeping the line full of water at all times. If the pipe line is particularly long and entirely exposed it may be necessary to provide a heavy expansion joint in the line. Leaky joints and broken flanges are generally the result of failure to provide for this expansion. Where the pipe line is to be permanent, it is advisable to bury it under at least 12 in. of ground.

While local conditions more or less determine the method of arrangement of pipes, Fig. 2, shows an arrangement that has proved very effective. After the overburden for one complete shovel cut has been removed, the main pressure line is uncoupled at the flanges and the pipe rolled back in sections and coupled up again preparatory to another cut. A gate valve is provided in each of the two leads from the main line, making it possible for the pipemen to change their positions without having to shut down the pump. Fig. 3 shows the method of accomplishing this where one nozzle only is being used. For handling from 500 to 700 gal. of water per minute at pressures ranging from 40 to 80 lb., the maximum amount of water at such pressures which it is advisable for one man to handle under conditions of comparatively shallow work, 3½ and 4 in. diameter 6-ply rubber hose has proven the most effective and economical. For ordinary stripping operations 50 to 75 ft. of this hose is usually sufficient. The writer has used 4 and 5-ply rubber hose for this service, but such hose quickly goes to pieces under this constant, hard and severe service. The writer has also used small monitors or giants with 4-in. pipe connections. With the ordinary depth of stripping of from 4 to 8 ft., however, monitors are not to be recommended, as too much time is lost in making and changing pipe connections.

Short play-pipes choke down the water too suddenly, causing a very irregular stream. Play-pipes at least 30 in. in length with a uniform taper, and provided with a small and a large screw tip or nozzle, should be used. A smooth, plain bore and not a ring nozzle should be used. A very convenient and practical device for supporting the hose and play-pipe is shown in the sketch of Fig. 4.

PUMPS

The reciprocating pump has an advantage over the centrifugal turbine pump in the great variation in pressure at constant discharge that it is possible to secure. Its disadvantages are its high first cost in the larger units, such as are necessary for hydraulic operations, and its low efficiency.

The turbine centrifugal pump is now almost universally accepted for all services where it is desired to deliver large quantities of water against high heads. It must not be inferred from this statement that the turbine pump is always to be recommended in preference to the reciprocating pump, as this is not the case. There is a limit to its application, but this limit is being continually widened by improvements in design, and at the present time the turbine pump is successfully employed for service where the reciprocating pump has been used exclusively heretofore.

The two principle factors which have assisted in the development of the turbine pump are the high speed motor and the steam turbine. The high speeds thus obtained make it possible to design a pump with comparatively few stages and with impellers of small diameter. This not only increases the efficiency of the pump, but also considerably reduces the cost. Turbine pumps are now built having efficiencies closely approaching 80 per cent.

Fig. 9 shows an average characteristic curve for a Worthington turbine pump operating at constant speed. It is shown that an increase in the head pumped against causes a reduction in the capacity and the horsepower required, and likewise, a reduction in the head increases the capacity and horsepower. If the total head is greater than that for which the pump was designed, the quantity of water discharged will be less than the full capacity, and may be even nothing at all if the head is sufficiently great. The power will also be less than the power required for the head for which the pump was designed. If the total head is less than the head for which the pump is designed, the amount of water will be greater than the normal capacity of the pump, and the power consumed will be greater.

This illustrates the difference which exists between the turbine and a pump of the displacement type. With a turbine pump the speed at which the impeller operates bears a fixed relation to the total head pumped against, and in order to increase the head it is necessary to increase the speed or reduce the capacity. Theoretically, the head varies as the square of the speed, and the capacity directly as the speed. With a displacement pump, however, the discharge also varies directly with the speed, but the pressure remains constant. With this in mind, it is shown that data regarding the conditions of operation should be verified carefully, in order to get results with turbine pumps. This is particularly necessary when constant speed induction motors are used.

The turbine pump has a distinct advantage over the reciprocating pump in that it is impossible to subject the pump and piping to a dangerous pressure, due to sudden closing of the discharge. The only effect is a slight increase in pressure, and the load on the motor is considerably reduced. Furthermore, air chambers and relief valves are not necessary, as the pressure will never build up to a dangerous point, even though the discharge valve be entirely closed.

With ordinary turbine pumps the horse-power required when operating at heads considerably below that for which the pump was designed, causes a dangerous overload on the motor. By selecting an impeller of suitable characteristic, however, it is possible to confine the overload to less than 25 per cent, which is the rated overload for all standard motors.

Pumps for hydraulic service are generally arranged for direct-connected motor drive, but those of the belted type and also direct-connected steam turbine-driven pumps can be used to advantage. It is common practice in the larger installations to arrange the pumps in pairs, piped so that they can be operated either in parallel or series. This makes it possible to double the pressure by operating in series when a hard strata is encountered. For removing the softer material, the pumps are operated in parallel, and doubling the capacity increases in proportion the amount of material removed.

DEPOSITION OF THE OVERBURDEN

Where it is possible to sluice the material in the worked-out portions of the pit it will be necessary to construct a levee or dike to retain the material and prevent it from spreading over the entire bottom of the pit. Small levees can be built of gravel and backed up with brush, to retain the material and prevent overflowing. Sewer pipe or box drains are placed in the center of the pond thus formed, their tops brought up and kept flush with the pond level (Fig. 5). In many respects a better method of retaining the material is by means of sheerboards. This method, known as sheerboard construction, is largely used in the building of dams and fills by hydraulicking. Under many conditions it is cheaper and more effective than the construction of earth or gravel levees. In this method the material is retained by two or more small bulkheads or sheerboards made of two 1 in. by 12-in. boards, nailed to 2 in. by 4-in. stakes about 7 ft. long. The 2 in. by 4's are pointed at one end and driven into the ground on about 4-ft. centers. (See Fig. 6.)

After the material is carried up to the top of the first row of sheerboards, a second row is built from 4 to 7 ft. back of the first. The bottom of this top sheerboard is placed from 5 to 10 in. below the top of the lower bulkhead to prevent the material from bulging and flowing out between the two bulkheads. The amount of seal necessary depends upon the nature of the material being sluiced. In ordinary loam 6 in. has proven effective, while in fine clay or sandy loam 10 in. is often necessary. As many sheerboards are built in the above manner as are necessary to take care of the stripping over a given area. In this method the water is taken off the top through spillways, which lead to a pipe drain or to a reservoir where the water is again used for sluicing.

If the pit has no natural drainage for the waste water, it is often possible to install an auxiliary pump and use this water again for sluicing. It would be necessary, of course, to excavate or provide a basin or reservoir of moderate capacity in the bottom of the pit sufficiently low to take the drainage or overflow from the spoil bank.

If the flume grades are heavy, however, it is often possible to drive the material as it is broken down directly to the flume, thus greatly increasing the duty of the water. Such conditions are the exception, however, and ordinarily the material must be broken up and put more or less in complete suspension before the flume will carry it. In such cases the water should be so directed as to remain with the material as long as possible.

As an example of what has been accomplished, an overburden 6 ft. deep, composed of a heavy loam, has been sluiced off in strips 90 ft. long and 50 ft. wide. The top of the gravel was practically level, the ground sluice having a fall of 3 ft. in 50. With one setting of the flumes and pipe connections, therefore, it was possible to sluice something like 1,000 cu. yd. of material.

METHOD OF DEVELOPMENT

The overburden being comparatively shallow, the main purpose here is to sluice as large an area as possible with one set of the flumes and pipe connections. In most cases it will be possible to strip a width equal only to one shovel cut, which is from 30 to 50 ft. See Fig. 8. If the top of the gravel deposit has a slope towards the flume, however, a much greater width is possible, depending, of course, on the degree of the slope. In the other direction the distance it is possible to go is also limited by the available fall to the ground sluice. In beginning to strip a given area, a trench is dug by hand down through the overburden and into the gravel a sufficient depth to obtain the necessary fall or grade of the ground sluice, and back a distance of about 3 ft. from the face of the stripping to provide a shoulder. Two short trenches are then dug at right angles to the main trench to provide room for the wings or deflector boards at the head of the first flume box. Bents are then erected, the flume sections put in place and sluicing begun. A comparatively narrow trench is first sluiced out from the head of the flume back as far as the stripping is to be extended. The upper end of this trench is then widened out to permit the pipemen to get their hose down on top of the gravel where the streams can be more effectively used. The material is then sluiced off in the manner shown in Fig. 7.

After the shoulders (5) and (5) (see Fig. 7) have been decreased to a width of from 3 to 5 ft., to prevent sluicing a part of the material over the face of the gravel bank, the streams are directed against the opposite side of these shoulders and the material sluiced backwards in a diagonal direction to the ground sluice. To provide room for the pipemen in removing these shoulders and to prevent the edge of the stripping from caving in and falling down the face of the gravel bank, it is necessary to strip the first "cut" sufficiently wide to provide a berm or shoulder of at least 8 ft.

If the stripping is deep and it is not possible, owing to the limited fall, to get the ground sluice deep enough, it is often advisable to obtain the necessary fall by leaving a portion of the stripping on the gravel until the greater portion is removed, when this wedge-shaped section can be sluiced off by driving it to the flume. This method is used in stripping stone quarries where the former method of lowering the flumes in the gravel is impossible. Where this drive is long and the material hard to handle, such as soft clay, it is often advisable to effect only a partial "clean up" with the water, the remainder being more economically taken off with teams and scrapers.

The direction of the stream on the material will depend entirely upon the amount of water, the character of the material and the grade of the flumes. Ordinarily the material must be put more or less in suspension before the flumes will carry it. In such cases the stream is directed against the bank in a direction opposite to the flow in the ground sluice and flume.

ECONOMY METHODS IN TRACK WORK

By W. C. NISBET

It may be questioned whether progress toward better methods in maintenance of way has kept pace with that in the maintenance of equipment. While naturally favoring the former department on account of long association, the writer, after casting up all the new processes or devices along economy lines generally adopted in the past ten years, ventures the answer that our progress in this line has been slight. Full credit is given for the patient technical labor toward improvements of rail and joint design and for the attempts to increase safety of track while working under reduced appropriation; however, in this paper we are not concerned with design or directly with operation.

Motor section cars are typical of modern improved devices, and it is true that there has been a large increase in their use, though by no means as large as the economy derived from their use warrants. No doubt when hand cars were being introduced there were those who deprecated their use as uneconomical and unsafe and who continued to walk their men to work. Rail handling and ditching machines are also reasonably common, but for regular track maintenance the pick, shovel and spike maul continue to be universally used in spite of the available power for tamping, drilling rail and placing spikes which the gasoline engine of the motor section car furnishes. In this, we might with advantage adapt the power tamping machines of the French railways to our conditions. While much of our American track cannot be tamped economically in this way, even on our dense

traffic divisions little advancement in method has been made if the experimental air tampers on the New York Central and the Long Island are excepted.

One feature retained in the track department, but now largely abandoned in machine and car shops, is payment by an hourly rate instead of in proportion to output. Throughout all modern industrial fields, some form of incentive payment is in use wherever possible, ranging from plain piece work to standard time with premium. There is no doubt but that every man works harder and uses more thought as to his work if he is paid in proportion to what he produces. This results in lower cost per unit.

In track work it would generally be necessary to figure the gang payments collectively, but similar methods are used in certain operations in car shops and in many instances in other industries. This apparent difficulty has a corresponding advantage in the incentive given the foremen to have all the men in the gang competent. This is exactly what is desired by the management, but under the ordinary plan the condition is often quite different.

It has been stated that, on account of differences in topography, climate and traffic, track work does not allow payment by piece work; yet we know that some operations in the car shops, for example, putting in wheels, trucks and drawbars paid for regularly at piece rates, uniform over a whole system of railroad, are frequently done under different circumstances, weather conditions and in varying locations where the conditions of work differ widely. The reason why this arrangement is satisfactory is because the variations average each other in the long run.

Without attempting to give further arguments as to the possibility of payment according to performance in track work, it is sufficient to say that one of the trunk lines has been using this method on three of its most important divisions under varying conditions for two years. The hourly rate is used plus a bonus which increases in proportion as the standard is approached for all jobs on which standard times have been set. The proportion of time covered by the standards varies from 50 to 90 per cent, depending mostly on the time of year. During the tie renewal season the higher figure is reached. The bonus is a per cent of the wages of both men and foremen. Quality of workmanship is controlled the same way as in the many shops where the pay is in proportion to production, that is by inspection and restriction of bonus payments to proper workmanship.

Another broad field awaiting more intensive cultivation is the development of simpler manual processes for the many operations which must continue to be done by hand, a definite campaign to find the best way and a still more definite campaign to instruct the foremen in these methods and to see that they are followed. Long since nearly all railways have had standards for most of their structures and the system is accepted as satisfactory and distinctly advantageous. In the same way there should be standard methods for surfacing track, renewing ties, raising track, etc.

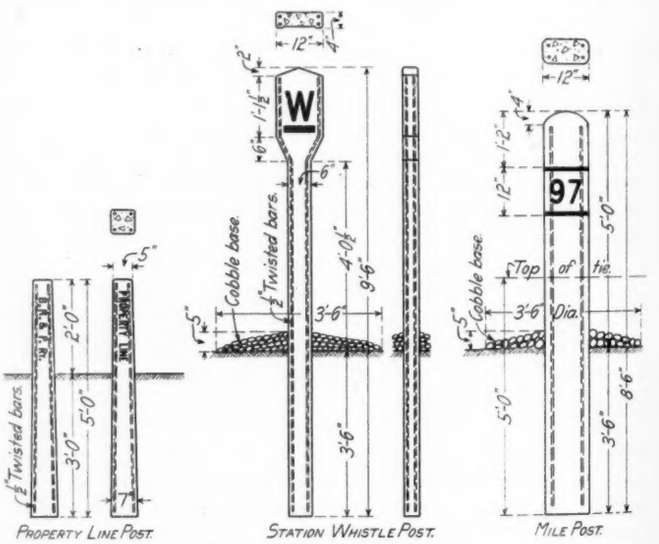
It may be quite generally supposed that in track work there can be but one method to follow in each operation or that if difference exists the result would show slight variation. The writer has looked into this subject on different railways during the last six months and the diversity of method found has been wide; in frequent cases there was great variation even on different sections of the same roadmaster's sub-division. An example of this was respacing ties in gravel ballast where one foreman was respacing 50 per cent more ties per man per day than any other foreman on the sub-division. The workmanship was excellent. The laborers were Americans, as was common in this locality. In this connection it is interesting to note that the second best production observed was made by a mixed gang of foreign laborers, rated as being indifferent workmen.

Some foremen are skilful and quick to find the easiest way to do any given piece of work; others, from inexperience or less ability, need careful teaching. Something more far-reaching than the usual roadmaster's supervision is needed, for, no matter how competent or alert the latter may be, he cannot leave the rest of the sub-division to itself while he teaches a green foreman for two or three days. The roadmasters as a class surely need no defense, as they constitute one of the finest types among railroad men in intelligence, loyalty and keen appreciation of responsibility, but they need assistance if the ideas advanced above are carried out.

Different opinions prevail as to the best method of furnishing such assistance. One way is to reduce the mileage of the sub-divisions. This is a simple plan, but it has defects. The writer favors the appointment of assistants who might be promoted from the foremen, members of the engineering corps or others who might be found to combine experience with the ability to impart knowledge and tact to follow up and check workmanship. These men should work under the roadmaster except as to standards which should be those set by the division engineers, just as the division engineer in the divisional organization takes orders from the superintendent except on engineering matters, in which he reports to the chief engineer or engineer maintenance of way.

B. R. & P. CONCRETE SIGN AND POST PLANT

The Buffalo, Rochester & Pittsburgh has adopted concrete posts and signs for a variety of uses and operates a plant at East Salamanca, N. Y., for the manufacture of these articles. Concrete fence posts are used universally, except in swamps and in places where there is a liability of slides, and since their adoption with the necessary concrete corner posts and braces they have proved very satisfactory. The company plant has manufactured about 15,000 of these posts, 500 concrete mile posts,



Details of Concrete Sign Posts

600 concrete property line posts and 100 concrete whistle posts. In addition, concrete signal foundations, concrete telephone booths and concrete pipe of various sizes are made at this plant.

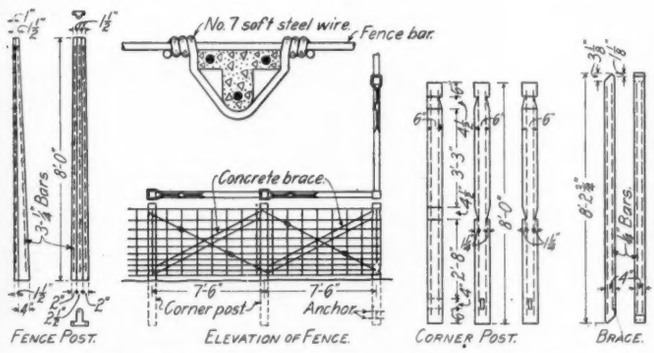
The post and sign plant is housed in a one-story building 90 ft. long and 19 ft. wide with an available floor space of 1,496 sq. ft. Coils of steam pipe are located under the concrete floor and along the sides of the building for heating, and a stationary boiler is provided in one corner to furnish the necessary steam. The cement to be used is stored in one end of the building, securely partitioned off to keep it perfectly dry. The balance of the building is used for the manufacture and curing of the posts and signs, which are stored here until required for use. No special equipment is required in this work other than ordinary concrete mixing tools, as the concrete is mixed by hand except in a few instances when a large amount is to be placed, requiring the use of a mixer to keep a supply on hand. The building is served by tracks along each side, allowing material

to be unloaded and the manufactured articles to be loaded with ease.

The designs of the principal signs and posts are illustrated in the accompanying drawings. The right of way fence posts are of the tapered T-section type 8 ft. long. The flange is 6½ in. wide and 1½ in. thick at the bottom and 4½ in. wide and 1 in. thick at the top, while the stem is 6½ in. deep and 2½ in. thick at the base tapering to 2½ in. deep and 1½ in. thick at the top. The reinforcement consists of three pieces of ¼-in. round bars 7 ft. 6 in. long, one bar being placed in each corner of the post. The line wire is attached to these posts by No. 7 soft steel tie wires, wrapped three times around the line wire on each side of the flange of the post. These wires are pulled tight to bite into the corners of the posts, thus preventing slipping.

The corner posts are 6 in. square and 8 ft. long. Notches 1¼ in. deep are cast 6 in. from the top and 3 ft. 6 in. from the bottom of these posts in which the diagonal corner post braces are set, and a slot 2 in. by 4 in. is provided through the post 6 in. from the bottom, into which short anchor bars can be placed at right angles to the fence line. All corners on these posts are rounded off to a ¼-in. radius. The reinforcement consists of four ¼-in. round bars 7 ft. 6 in. long. Five of these posts are placed at each corner on 7 ft. 6 in. centers, thoroughly braced and tied. The braces used with these corner posts are 8 ft. 2¾ in. long and 4 in. square, with mitered ends to fit into the notches provided in the corner posts. These braces are also reinforced with four ¼-in. round bars 7 ft. 6 in. long, and all corners are rounded to a ¼-in. radius.

The property line posts, which are set on all property corners,



Details of Line and Corner Fence Posts and Braces

opposite the beginning and the end of all curves and at 1,000-ft. intervals on tangents, are 5 in. square at the top and 7 in. square at the bottom with a length of 5 ft. They are set in the ground 3 ft. On one side of the post are moulded the letters "B. R. & P. Ry.," and on the opposite side are the letters "PROPERTY LINE." These letters are 2 in. high. The side of the post with the latter lettering is placed toward the main track whenever possible. The post is reinforced with four pieces of ½-in. twisted steel bars 4 ft. 6 in. long. The corners of the post are rounded to a 1-in. radius.

The concrete whistle posts, which are set on the engineer's side of the track 1,320 ft. from highway crossings and 7 ft. 6 in. from the near side of the post to gage side of the near rail, are 9 ft. 6 in. long, 6 in. wide and 4 in. thick at the bottom and 12 in. wide and 4 in. thick at the top. The latter width is only maintained for a length of 15½ in. to provide room for the letter "W." These posts are set in the ground 3 ft. 6 in. The letter is 7½ in. high, ¾ in. deep and 1¼ in. wide and is placed only on one side of the post, the other side being left blank. This post is reinforced with four pieces of ½-in. twisted steel bars, 8 ft. 2 in. long and the corners are rounded to a ¾-in. radius. Station whistle posts are identical with those described except that a line 8 in. long is cast under the letter "W." These signs are placed ½ mi. from stations.

The concrete mile posts are made in two widths, one for one or two figures, and one for three figures. The former are 6 in. thick and 12 in. wide and the latter 6 in. thick and 14 in. wide. All are 8 ft. 6 in. long with the upper 4 in. rounded off from the edges to the center. The figures, which are 6 in. high, are set into the posts between two horizontal lines ½ in. wide placed 14 in. and 26 in., respectively, from the top of the post. Both sides of the post are made the same. The reinforcement consists of four pieces of ½-in. twisted steel bars 8 ft. long and the corners are rounded to a 1-in. radius. These posts are set 3 ft. 6 in. in the ground, and are placed 10 ft. from the center of the post to the gage side of the near rail on the right hand side of the track going south from Buffalo and Rochester. They are used both on the main line and branches.

A mixture of 1 part cement and 3 parts fine gravel is used in the fence posts, corner posts, and corner post braces, while a 1:2:4 concrete mixture is used in the other cases. The fence posts are cast in gang moulds of 30 each, mounted on trucks. Three of these batteries are used, giving a capacity of 90 posts at one pouring. The other posts and signs described are moulded in wooden forms made of 2-in. surfaced yellow pine, the parts of the moulds being fastened together by hinges and hasps in all cases, except the mile post form, which is clamped in position. In all cases the forms are constructed so that they can be readily removed from the posts after the concrete has set sufficiently, which is about 48 hours. After removing the posts from the forms they are placed on end along timber racks outside of the building for one week to cure properly. During this time they are sprinkled once a day, or as often as necessary, and covered to protect them from the action of the weather. At the end of the week, or when they are strong enough to permit them to be removed, they are corded up in a pile ready for shipment. During the winter they are treated in much the same manner with the exception that they are not taken out of the building until thoroughly cured. The building is kept at an even temperature of 60 deg. After the posts are removed from the forms, the latter are thoroughly cleaned and sparingly coated over with fuel oil to prevent the concrete from sticking to the form when being removed. In the case of the property line post and the whistle post the surface of the concrete is rubbed down to a true, even, uniform surface as soon as the form is removed, using a small briquette and clean water. This briquette is made of 1 part of cement and 2 parts of sand mixed with clean water.

The letters used on these posts are V-shaped and indented into the concrete, the indentation being painted black in the case of the whistle and mile posts. An advantage of this type of letter is that it eliminates the necessity for restenciling the posts from time to time. In the case of the whistle post the letter "W" and the line, when it is used, are fastened to the bottom of the forms and the post made face down. The figures and the cross lines on one side of the mile posts are secured to the forms, while the corresponding depressions for the other side of the posts are moulded into the concrete from the exposed surface while it is in the form. The weights and detailed cost of manufacture of these various posts and signs are shown on the accompanying table.

We are indebted to G. H. Stewart, master mason, for the foregoing information.

		Cost									
			Material								
			Cement		Aggregate		Reinforcement				
	Weight, lb.	Labor	Amount sacks	Cost	Amount cu. ft.	Cost	Amount lin. ft.	Cost	Total matl. cost	Total cost
Fence post....	87.5	$0.055	0.30	$0.07	0.623	$0.02	22.5	$0.09	$0.18	$0.23
Corner post...	285	0.18	0.81	0.19	1.90	0.05	30.0	0.12	0.36	0.54
Corner post brace	146	0.15	0.355	0.08	0.875	0.03	30.0	0.12	0.23	0.38
Property line post	202	0.50	0.29	0.07	1.65	0.05	18.0	0.18	0.30	0.80
Whistle post...	410	1.00	0.41	0.09	2.31	0.07	36.66	0.37	0.53	1.53
12-in. mile post.	560	0.80	0.88	0.20	5.64	0.17	32.00	0.32	0.69	1.49
14-in. mile post.	690	0.80	1.15	0.26	6.63	0.20	32.00	0.32	0.78	1.58

Recent Important Developments in Ballast Practice

The Merits of Contracting This Work and of Cleaning Rather Than Renewing Material on Two Large Roads

STONE BALLASTING BY CONTRACT

By John Evans

Division Engineer, Michigan Central, Detroit, Mich.

On the greater part of the stone ballasting on maintenance work done by the Michigan Central since the opening of the working season in 1909, the labor of putting the stone under the track has been handled by contract. A total of approximately 90 miles of double track has been ballasted in this way, distributed over the seasons of 1909, 1910, 1911 and 1913. No stone ballasting was done in 1912 or 1914.

There has been practically no change in the method of procedure since the practice of doing this work by contract was introduced. The contract provides unit prices per foot of track for skeletoning out the old ballast to the bottom of the ties; lifting the track to the grade stakes, and surfacing, lining and trimming. All work not covered by the contract prices, such as unloading the stone, putting in and spacing ties, making a preliminary lift on gravel or cinders, widening banks, etc., is done either by the railroad forces or by the contractor on force account. In either case the unloading of the stone is done under the railroad company's supervision, and the contractor is allowed extra compensation when, on account of shortage or surplus in the distribution, he has to move stone more than 300 ft. to complete the finished ballast section. The railroad company provides bunk cars at its own expense for the contractor's men and supplies all tools and equipment needed in the work. It also furnishes free transportation for the men over its own lines.

The track is given a minimum lift of 6 in. on stone. The contractor makes lifts up to and including 8 in. at the contract price for lifting and for lifts over 8 in. an extra allowance per foot of track for each additional inch of lift is made. In cases where the stakes as set by the engineer show a lift of more than 6 in. for any considerable length of track, the lift to within 6 in. of the top of the stakes is made with gravel or cinders. The contractor is allowed extra compensation on a force account basis where the throw in lining track to the center stakes exceeds 1 in.

The railroad company places an experienced track man on the work as inspector. This man looks over the track after it has been surfaced, lined and trimmed, and either accepts it or notifies the contractor to do such additional work on it as may be necessary to make it acceptable. After the track has been accepted by the inspector, the railroad company is responsible for its maintenance.

The work turned out under the above arrangement has been entirely satisfactory. The track has ridden well when finished and has retained its line and surface fully as well as it has in the best work done by our own forces. We are doing no stone ballast work at the present time, owing to financial conditions, but it is practically certain that our future work of this kind will be handled by contract. As a matter of fact, the contract system of doing track maintenance work is expanding with us and we are extending its application from time to time to new items with satisfactory results.

The men employed on the work are Italians and the contractor is an Italian with wide experience in business dealings of all kinds with his countrymen. He keeps in close touch with the labor situation throughout the country, and his knowledge and experience results in the finding of a better class of men and in getting more and better work out of them. Since starting in this work he has developed several good Italian track foremen.

The contractor, being financially concerned with the amount of work done, has a more effective interest in increasing the output than our own foremen have, regardless of how capable or conscientious they may be. Under this system small concessions can be made to the men in the way of increased pay, whereas wage rates paid by the railroad company are not adjustable. For this reason local shortages in the labor market do not affect the size of the contractor's gangs as seriously as they do the railroad company's. Furthermore, a small increase in pay is usually more than offset by the additional effort which it results in.

Doing ballasting by contract relieves our roadmasters and assistant roadmasters of the greater part of the supervision of this work at the time of the year when their attention is badly needed for other branches of maintenance.

A possible improvement in our method from the railroad company's standpoint would be to have the contractor supervise the unloading of the stone and be responsible for its proper distribution. In this way the clause providing for an extra allowance in case stone has to be moved more than 300 ft. could be done away with. This should work no hardship on the contractor, because it is our experience that very little stone has had to be moved more than the specified distance. There have been several occasions where the contractor has made claims on account of the alleged improper distribution of the stone. In most cases these claims were not allowed, because they did not appear to be justified by the terms of the contract, or to be based on sound argument. If the contractor were unloading the stone, all opportunity for argument from this source would be done away with.

The proportion of the work done under contract could be increased and possibly the cost of the work reduced by having the contractor put in what ties are needed at the time of ballasting at a unit price per tie. I think it not improbable that this will be tried out in some of our future work.

The ballasting done during the season of 1913 included 12 miles of double track on the East division of the main line about 55 miles west of Detroit. On this particular job the total number of men, including force account and contract work, varied from 110 to 140. The skeletoning gang numbered about 15 men, and the lifting gang 50. The remainder of the men were in a gang which worked between the skeletoning and lifting gangs, putting in and spacing ties, widening banks, etc.

The lifting gang did all the track raising, both on gravel and stone. It also surfaced, lined and trimmed the track. The lifting on stone was done in stretches of single track one mile long; that is, no lifting was done until stone was distributed ahead for one mile of track. The lifting of this mile was ordinarily one day's work for the lifting gang. After being raised, the track was allowed to stand for not less than three days before surfacing, lining and trimming was started. Between the time the track was lifted and the time it was finished a speed limit of 30 miles per hour was in effect. After the mile of track had been surfaced, lined and trimmed it was looked over by the inspector, and, if accepted, the speed restriction was removed.

CLEANING STONE BALLAST WITH SCREENS

By H. M. Church

Division Engineer, Baltimore & Ohio, Baltimore, Md.

Previous discussions of the performance of ballast screens and the methods employed for cleaning stone ballast have shown in detail the great saving in both labor and material that can be effected by their use. On the Philadelphia and Baltimore divisions of the Baltimore & Ohio, where traffic is heavy and where considerable ballast has been cleaned, the

results have been quite gratifying and have led to the conclusion that the cleaning of stone ballasted tracks is justified where only one cubic yard of stone may be conserved in a distance of 8.1 lineal feet of double track; that is, one cubic yard of material saved in this distance justifies the employment of the necessary labor to screen it out. In the cleaning of several miles of freight tracks formerly ballasted with stone, it has been amazing to see the amount of stone so saved. Tracks that had deteriorated by the presence of dirt and cinders in the voids of the stone ballast were restored to a condition that had formerly been obtained only by the wholesale removal of the material from the tie cribs; loading and taking it away as waste, an extravagance that has been overcome by the use of screens.

The employment of ballast screens has been found economical in the "out of face" cleaning of single tracks and multiple track and in yards; also in combining the cleaning with tie renewals. As an example of the saving effected, an organization consisting of 12 men, one foreman and one water boy cleaned 200 lineal feet of standard ballasted double tracks per 10-hour day where tracks were 12 ft. centers, using 3 screens, one on either side and one in the center between tracks. The ballast was cleaned 12 in. below the bottom of the tie on the berme, 6 in. below the bottom of the tie in the center ditch and level with the bottom of the tie in the cribs. It amounted to the handling of 104 cu. yd. of stone in the 200 ft. stretch per day. The unit costs of this progress were arrived at as follows:

Length of double track cleaned per day, lin. ft.	200
Cubic yards stone cleaned per day	104
1 foreman at $77 per month.	
1 water boy at 15c. per hour.	
12 laborers at 15c. per hour.	
Total cost per day	$22.46
Total cost per lin. ft. double track	0.112
Total cost per cu. yd. ballast	0.216

The ballast yielded 400 wheelbarrow loads of dirt per 100 lin. ft. of track, representing approximately 50 per cent of the volume of the stone. The voids in the stone amounted to 40 per cent, so that the loss of volume in cleaning amounted to 10 per cent. To determine the extent to which the material conserved justifies cleaning ballast we have the following:

Cu. yd. dirty ballast handled	Percentage of total volume		Total cost cleaning	Cost per cu. yd. stone saved	Cost per cu. yd. new stone unloaded on track
	Stone	Dirt			
104	100	40	$22.46	0.216	1.00
104	90	50	22.46	0.24	1.00
104	80	60	22.46	0.27	1.00
104	70	70	22.46	0.31	1.00
104	60	80	22.46	0.36	1.00
104	50	90	22.46	0.43	1.00
104	40	100	22.46	0.54	1.00
104	30	110	22.46	0.72	1.00
104	21.5	118.5	22.46	1.00	1.00
104	20	120	22.46	1.08	1.00

When only 21.5 per cent of the total volume of material handled passes over the screen and is saved for re-use, the screening operation becomes as expensive as the application of new stone. In other words, 21.5 per cent of the volume per lineal foot of double track represents the amount of stone which must be saved in order that screening be economical, which is equivalent to the conservation of only 1 cu. yd. in 8.1 lin. ft. of double track.

Aside from this very important economy, the practice of screening ballast instead of putting the track up on new ballast admits of maintaining surface without disturbing the roadbed under the ties, a factor of vital importance in ideal track maintenance. It has the advantage of being quicker and more thorough than the fork method; laborers do not tire as quickly under it, and with the screens arranged as described the invariable tendency is for the men to compete with each other for speed.

CHARACTERISTICS OF SLAG AND CHAT BALLAST

By P. H. Hamilton

Roadmaster, St. Louis & San Francisco, Memphis, Tenn.

All trackmen agree that crushed limestone makes the best ballast under any traffic, or in any locality. However, a large per cent of the railroads in the United States are not so situated that they can secure limestone ballast, or are not financially able to purchase or to produce it. Consequently they are forced to use the best natural ballast available and the refuse, or by-products, from other industries are often utilized.

Cleaning Stone Ballast with Screens

Slag is used extensively by roads entering the great iron and steel producing centers, some of them transporting it hundreds of miles. Slag is the residue stone from blast furnaces, and pig iron smelters produce the best slag. There are many classes and varieties, ranging from snow white to dark brown in color, some are chalky in substance and others hard as flint rock.

When the slag comes from the furnace it amalgamates, and it is necessary to blast it loose before loading. That used for ballast is seldom classified or screened, most roads or contractors loading it directly onto ballast cars with steam shovels. Consequently there is great variation in the size of the particles. The larger per cent runs from ½ in. to 2 in. in diameter; but in a car of fine slag we find many pieces larger than a water bucket, which often cause trouble in unloading. Sometimes they block the opening in the bottom of the car. When a drag tie is being used for leveling the ballast these pieces frequently catch on the track and derail the car being unloaded. Where the ties have been properly spaced previous

to unloading slag these larger pieces often drag on the ties, bunching them and making respacing necessary. These larger pieces may be broken up by hand, but it is more often necessary to discard them when applying the ballast.

The darker slag, called glassy slag, breaks into small particles of prismic form, ranging from ½ in. to 2 in. in diameter, and is considered the best slag for ballast. The white, or grey slag, is lighter in weight. Some of it resembles limestone, and sometimes it resembles coral and breaks up very easily when being tamped. That which resembles limestone makes good ballast, but it is not uniform in size and generally contains a large percentage from 2 to 6 in. in diameter. Sometimes these larger pieces can be broken with spike mauls or tamping picks, but more often it is necessary to lay them to one side and finally to move them to some place where they can be used for bank protection.

While it is not the general practice to classify slag for ballast, I believe that it should be done as it is loaded, and all pieces too large for the purpose should be run through a crusher, or discarded at the pit.

Slag ballasted track can be worked at any time of the year. It drains well and it is practically dustless. It will keep down the growth of vegetation, but it should be cleaned as often as limestone ballast. This is especially necessary on heavy grades where there is an accumulation of engine sand and front-end cinders. Where the embankments are sodded with Bermuda grass the only way to keep this grass out of the ballast is to clean it every two years. Slag has been objected to on account of being chemically injurious to the rails and ties, but this effect is not noticeable. When unloading slag a faint gaseous odor is noticeable, and the dust causes a smarting of the eyelids. However, exposure to the air soon eliminates this chemical property. Like crushed stone, slag is hard to work, and the insertion of ties is more expensive in slag. It is applied and the track is maintained practically in the same manner as with crushed stone.

Chat ballast is used for ballast by all of the roads entering the mining districts of Missouri, Kansas, Oklahoma and Arkansas and is transported hundreds of miles. Chat is flint or ore bearing rock, broken into small angular pieces averaging ¼ in. to ½ in. in diameter. It is the refuse from the jigs at the lead and zinc mines after the mineral has been separated from the stone. It is crushed very fine to get all of the mineral out of it, and is known as tailings at the mines after it has gone over the jigs and all of the lead or zinc ore has been taken from it.

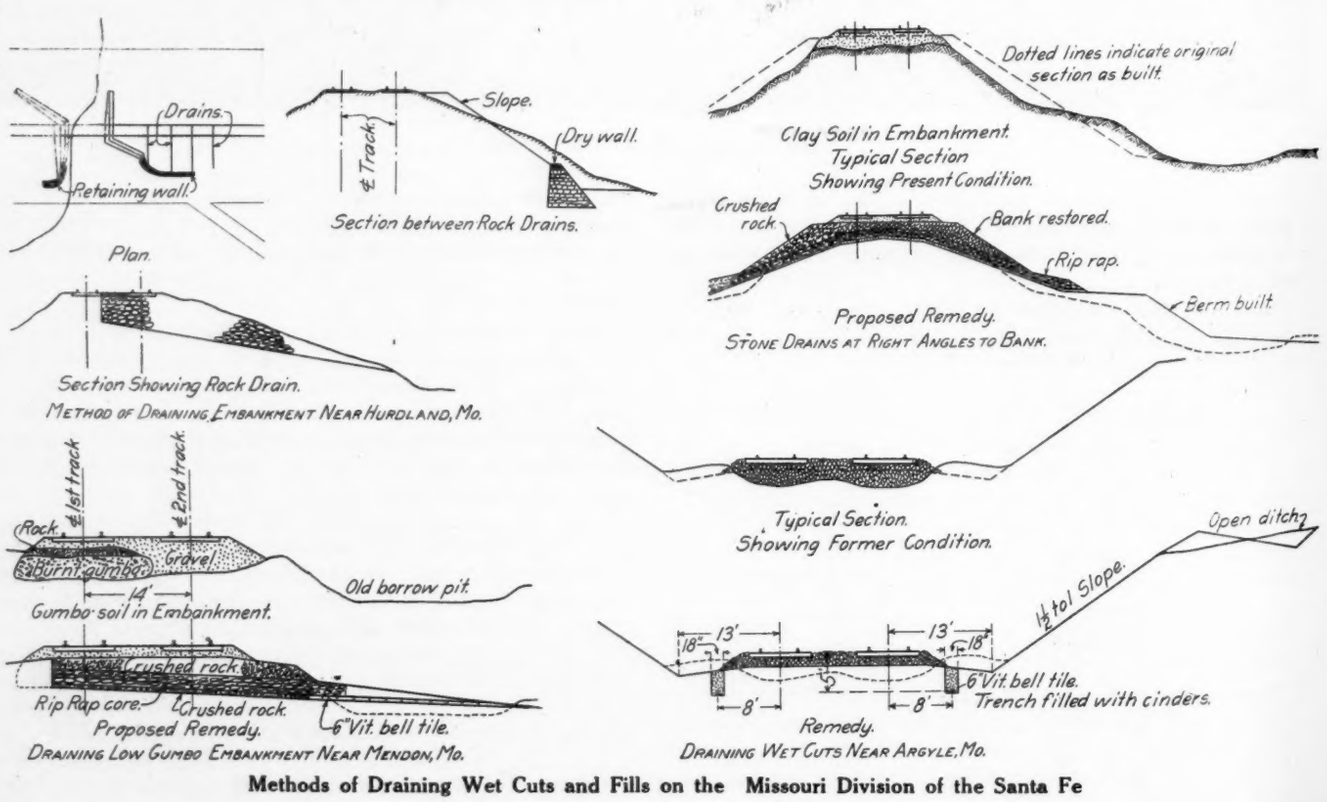
The chat is carried away from the jigs in a stream of water through a trough emptying on to a tailing pile. Sometimes the tailing trough empties into a ballast car, but more often the chat is loaded from abandoned tailing piles with steam shovels. The former method is cheap, but the stream of dirty water passing through the car is injurious to it. It also packs the ballast in the car and makes it hard to unload.

Hand jigged chat is larger than that which goes through the mills, and makes better ballast, but the quantities are limited. Chat has a good weight and is hard. It does not crumble or wear out quickly. It sheds water well, but it is necessary to have a heavy shoulder to hold the track in line, and to keep it from becoming center bound. It is easily worked, all of the tamping being done with shovels or tamping bars. Sometimes "end tampers" are used. Vegetation will not grow in it. At one time the mine owners or mill men were willing to give chats to anyone who would remove them, but now nearly all of the chat piles are controlled by contractors who lease a pile to a railroad, or furnish chat loaded on cars. It costs from 10 cents to 15 cents per cu. yd. loaded on cars.

DRAINING EMBANKMENTS IN MISSOURI

Because of the nature of the soil the railroads in northern Missouri have great difficulty in securing adequate drainage of embankments as well as of cuts. In common with other roads, the Santa Fe has given a great deal of attention to the solution of this problem, and has placed rock drains in embankments at a number of points with satisfactory results.

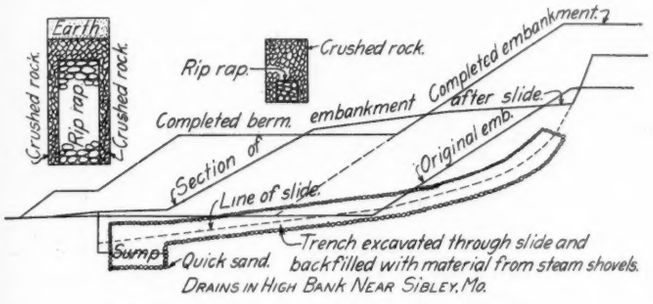
At one point 1½ miles west of Hurdland, Mo., water formerly collected under the ballast, causing slides in the embankment that interfered with traffic not only on the railroad but on an adjacent highway. This condition was overcome by the construction of five rock drains in the embankment extending from the



Methods of Draining Wet Cuts and Fills on the Missouri Division of the Santa Fe

toe of slope of the eastbound track to the inside end of the tie under the westbound track, trapping the water pocket under the latter track. These trenches were excavated to a depth of seven feet under the track and filled with crushed stone and riprap. A dry retaining wall was also built out from the wings of the abutments for a short distance, connecting with these drains as shown in the drawing and the accompanying photograph. Following the constructoin of this system of drains no further difficulty has been experienced in maintaining the track and trains have operated over it at the regular scheduled speeds.

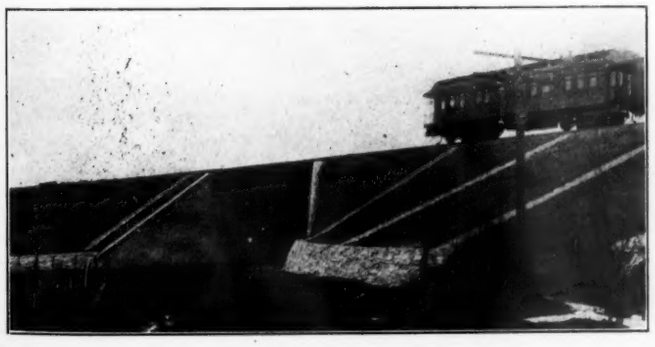
At another point near Mendon where the track was on a low gumbo embankment several barrels of water ran out when a trench was cut into it during the very dry season last year. To



Trenches Built in a High Fill at Sibley, Mo.

drain this place permanently it is planned to dig trenches, filling them with crushed rock with a 6-in. vitrified drain tile in the bottom leading to a drainage ditch parallel with the tracks beyond the toe of slope. At other points difficulty has been encountered with water collecting under the ballast, causing the shoulder to slough off. The drawing shows the manner in which this has been overcome by the construction of stone drains at right angles to the track. In general these drains are built of crushed stone with a core of riprap to facilitate the flow of the water.

In the vicinity of Argyle considerable difficulty was experienced in maintaining the track through clay cuts where the ballast had become compacted into pockets under the tracks somewhat as shown in the accompanying drawing. As the bottom of these pockets was below the side ditches there was no outlet for the



View of the Rock Drains Near Hurdland, Mo.

water. This condition has been overcome by correcting the subgrade conditions, leveling up the ballast and constructing trenches 18 in. wide and extending 5 ft. below the base of the rail, 8 ft. out from the center of the adjacent track. A 6-in. vitrified tile drain was also laid in the bottom of each trench, after which it was filled with cinders above the tile. Since the intsallation of these drains slow orders have been removed permanently while the tracks have been maintained in better condition and at less cost.

In rebuilding the bridge across the Missouri river at Sibley, Mo., it was necessary to raise the grade of the embankment for 10,000 feet on the east approach and to widen it for second track, requiring the addition of 1,750,000 cu. yd. of material. As this material was placed in slabs, and as it consisted of clay, considerable difficulty was encountered with the shoulder sliding off from time to time. To remedy this a trench approximately 16 ft. wide was excavated outside of the toe of the slope and parallel with it to a depth of about 8 ft., which brought it below the level of the strata on which the superimposed material was moving. Sumps were excavated to quicksand at intervals along this trench as the slide was too deep to drain into the surface ditches along the right of way line. Eighty trenches were then excavated into the embankment along the line of the slide and filled with riprap and crushed rock. The large trench was backfilled with material brought in by train from a distance rather than refilling it with the gumbo originally taken out. The berme was constructed over it by work trains. This work was done early last year and it has proven entirely satisfactory so far, while there is no indication that it will not continue so.

SOME OF THE MORE IMPORTANT ELEMENTS IN THE MAINTENANCE OF TRACK

By W. F. Rench

Supervisor, Pennsylvania Railroad, Perryville, Md.

There are certain basic requirements for substantial track which may not be slighted. They are, generally speaking, three in number: Drainage, which has for its two principal adjuncts roadway design and ballast cleaning; adequate crosstie replacement, and proper force and methods for maintaining line and surface. There are other important items such as the organization of the working forces, rail repairs, special equipment, etc.; but those first named are of primary importance.

ROADWAY DESIGN

The standard plans of the road exhibit the ideal cross-section, but most maintenance rules wisely permit a deviation from the plan when necessary to meet local conditions. The essential requirement from the maintenance standpoint is that transverse drainage be afforded not only to the track, but to the sub-bed also and that proper longitudinal drainage be secured either through the surface ditches or by submerged pipes.

The question of draining wet cuts has been a favorite topic for discussion in recent times and it generally appears that the solution found is one of strictly local application. It may not be amiss, however, to refer briefly to three recent developments along this line. The use of a wooden box drain between tracks with its bottom 4 ft. below the base of rail and containing numerous peforations to allow the water to percolate freely has rendered possible the maintenance of high speed service through very bad quick-sand cuts in several instances. The raising of troublesome stretches of road sufficiently to provide a blanket of cinders from 12 in. to 24 in. thick between the ballast and the wet soil has furnished present relief and invariably gives expectation of permanent results. One of the main-line divisions of the Pennsylvania has introduced a rather extensive system of longitudinal underdrainage for wet cuts and the advantage obtained has been quite remarkable. The drain is of 12-in. glazed terra cotta pipe laid upon a floor of boards 5 ft. below the base of rail and 5 ft. from the gage line in both ditches. In order that the water may have free access to the drain the joints are left open. To exclude the soil these have hay packed about them. The entire trench in which the pipe is laid is then back filled with ballast or coarse pebbles. To secure the very best results the sides of the trench and the top of the ballast filling are likewise protected from the entrance of soil by a layer of hay.

BALLAST CLEANING

No drainage system is of complete benefit unless the ballast is kept clean. The depth to which this cleaning should go is a variable one, but it should generally be to the bottom of the ties in the inter-tie spaces and several inches below the bottom of the tie in the ditches. It is desirable to carry the cleaning of the ditches somewhat below the bottom of the

ties as a labor saving item, because when the sub-grade is reached work with the ballast forks is greatly facilitated.

Cleaning the ditches is a slow and expensive process, but it may be rendered less so by the use of a device for loosening up the ballast which has been tried with good success. It is known as a ballast plow and consists of a fish-tail spud about 6 in. long and 4 in. across which is rigidly attached to an arm which can be moved out or in. The arm is attached to a flat car which is heavily weighted to give it stability and to prevent derailment while the car is moving with the plow plunged into the roadbed. All movements of the plow and arm are made by the use of compressed air.

The car moves at a rate of five miles per hour and can thus be used to loosen up a considerable stretch of center ditch in a day. This device saves the labor of many men with picks and the loosening of the ditch in itself supplies improved drainage, which is thus effective somewhat in advance of the actual cleaning. The average accomplishment of one man cleaning a center ditch after it has been loosened by the plow is 100 ft. in one day. It will be found that this dirt with the stone forked out makes an excellent border for the stone ballast on fills as its nearly dead black color contrasts pleasingly with the lighter stone and it is the best material known for retarding the growth of grass and weeds.

The cleaning of track is not of the maximum benefit until a raise is made and a clean bed of ballast applied beneath the ties. If there is a good sub-bed the raising may be made in lieu of the cleaning of the tie spaces, or similarly if the tie spaces are cleaned the raising may be omited, although track never suffers from a light surface raise. Indeed, periodical raising, particularly on lines of heavy tonnage, is the life of main track. The raise should generally be about 2 in., which can be made without flagging. The periods between successive raises are variable for different kinds of roadbed and for different classes of traffic. Generally, for a well-maintained track mostly under passenger traffic, raising once in four years is sufficient, while under a traffic with heavy freight movement predominating, once in two years is none too much and there are places where the service is extreme and the roadbed bad that require this treatment every year.

Its necessity is determined by the appearance of a center-bound condition of the track which fails to give comfortable riding even when the line and surface are perfect to all appearances. The condition as is well known arises from the track having settled into the bed until the unyielding part of the tie support is at the middle of the tie. It is to postpone this condition that maintenance rules prescribe that the tamping should not be carried more than 15 in. inside the rail.

When the roadbed is very hard raising the track in advance of tie respacing or tie renewal effects a large saving in labor. But when the ballast is fairly clean it will generally be found preferable in either work to follow the respacing or the renewal with a light surface raise so that a uniform bed may be secured.

CROSSTIE REPLACEMENT

There has been at times in the past great activity on the part of maintenance officers to effect a stringent restriction in the use of crossties. The thought doubtless is that such restriction is a maintenance economy. But it is a temporary saving, the direct result of which will be a measurable increase in the labor of maintenance later on. There is a stage in the life of a crosstie when no matter what its appearance may be its usefullness in main track is ended. When continued respiking through the absence of tie plates has resulted in the condition best described by the expression, "spiked to death;" when through repeated tamping the bottom of the tie has become rounded and has no base or an insufficient one for adequate bearing upon the bed; when through decay the function of preserving the gage or the surface are lost, then the continuation of the tie in a main track becomes a separate item of expense. Every main line supervisor knows that the track which has a large percentage of inferior ties is the one where most of the sub-division labor is spent.

Appreciating the importance of good tie support the supervisor should carefully ascertain the normal renewals for his sub-division and it should be zealously sought to apply the indicated number of ties year by year. The total number of ties in the main tracks of the main line, divided by 7, in the branch main tracks, divided by 8, and in the sidings divided by 9 will supply the average yearly requirement, where untreated ties largely predominate or where past use of tie plates has not been plentiful. It is assumed that the mileage will be corrected for new tracks that require no renewals and for the distance through switch connections and over bridges. Unless the indicated number of ties is used year after year, the excellence of the track will diminish. Maintenance of good timber on bridges and through switch connections, is of no less importance. The utility of tie plates in prolonging the life of ties and in preserving the gage is so fully recognized that all roads are committed to some definite plan for ultimately equipping all ties both on curves and tangents with this necessary accessory.

LINE AND SURFACE

The maintenance of a good railroad basically requires that the drainage shall be well taken care of and that the ties shall be kept in good condition, but there is also necessary the periodical repair of the track as regards line and surface. This repair should be made on a regular program to be of maximum benefit. The year on the Pennsylvania line is punctuated every seven weeks by the trip of the Track Inspection committee which determines by observation and by the records of certain instruments the relative merits of the different supervisors' sub-divisions by which prizes of considerable value are awarded at the close of the working year. These seven weeks' periods serve to divide the year into convenient intervals for restoring the detail line and surface.

Immediately upon the passing of the inspection party a period of four weeks of steady prosecution of tie renewals, ballast cleaning, rail replacement and track raising is entered upon. At the end of this period three weeks are given over to lining and surfacing the main tracks, so that seven times during the year the riding features of the road are brought to the highest state attainable and naturally through the remainder of the year they do not fall very much below this standard. As far as possible during the four weeks' period of applying material the road is cleaned of scrap, old rails, old ties and dirt. But on busy lines it is not practicable to keep a work train cleaning up with the progress of renewals, and the remaining three weeks, while active renewals are suspended. furnishes the needed time for completion of the cleaning, so that upon the inspection dates the road is likewise fully policed.

As floating gangs are proverbially inefficient in the finer surfacing their labor is mainly devoted to rail renewal and ballast cleaning. With such work lifted from the sub-division forces it has been found that very good results in maintenance have been secured by an allotment of laborers 50 per cent greater than the miles of main track, those sub-divisions having interlocking or other special burdens being allotted additional force.

On busy lines it is important to utilize every advantage that makes for decreased surfacing and to this end joints are eliminated from road crossings by the use of 60 ft. rails; the ties under road crossings are maintained in the best condition possible; the ballast is cleaned below the ties at such points each year late in the season to diminish the trouble from heaving; anti-creeping devises are generously used to modify the trouble from rail running which causes distortion both of the line and the gage; and prompt correction of defective ash pans is made to save burning good ties in the track and to avoid imposing additional burden of dirt upon the roadbed.

Using Bulk Cement on Railway Construction Work

A Discussion of the Advantages of This Practice Including a Reduction in Cost, Methods of Handling, Etc.

BY MAC RAE D. CAMPBELL

Although bulk cement is still more or less of an innovation, the idea has a number of strong points to commend it and has won considerable endorsement from several railway systems. Among these are the Chicago, Milwaukee & St. Paul; the Chicago & Alton; the Chicago & North Western; the Duluth, Missabe & Northern; the Bessemer & Lake Erie; the Union Railway; the Pennsylvania, and the Baltimore & Ohio. One cement company reports that bulk shipments from its mills have increased from 15,485 bbl. in 1912 to 180,258 bbl. in 1914.

The economy resulting from using cement in bulk is made up of a number of items. First, there is a saving of 2 cents a barrel in the price made by the manufacturer through eliminating the labor and expense of sacking. Probably no user of cement has escaped the trouble and annoyance consequent upon handling empty sacks preliminary to their return to and redemption by the cement manufacturer. Cement in bulk eliminates sack troubles. Experience has shown that mixing crews of the average size may be reduced by two men, each of whom probably receives $2 per day, which has been estimated as an additional saving of from 2 to 3 ct. per cubic yard of concrete in a daily

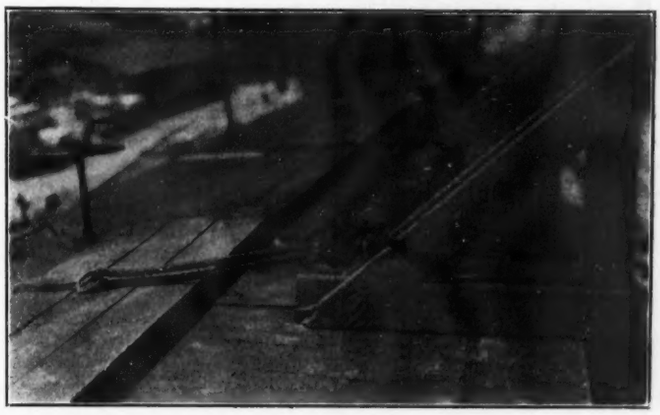
Runway for Unloading Bulk Cement from a Box Car Hung by Brackets from the Roof

output of 150 cu. yd. Another saving comes from the elimination of the customary charge made against the job to cover damage or loss of sacks, 2 ct. a barrel being a conservative estimate of the amount that must be so charged off. Collectively the tangible items show a saving of not less than 6, and in some instances perhaps as much as 10 ct. a barrel.

The Chicago, Milwaukee & St. Paul is using bulk cement on the Evanston division track elevation work which has already involved somewhat over 4½ miles of retaining walls. On the Council Bluffs division over two miles of retaining walls were constructed with bulk cement. It was also used by the Chicago & Alton in track elevation work and in connection with shop and other construction work at Bloomington, Ill.

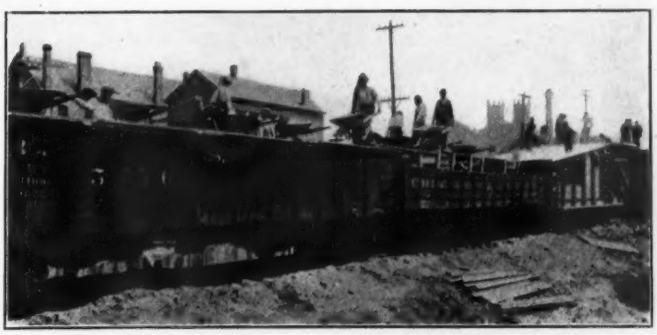
On many roads that are employing concrete construction to an increasing extent, the construction equipment might include a concreting work train outfit planned for using bulk cement. It is probably safe to say that once equipped with an outfit of this kind the engineering department would find employment for it not fewer than eight months a year in most sections of the country, while in the South it would have even a longer period of usefulness. Various types of mixers and associated equipment have been used on railroad construction work where bulk cement has been a feature. Usually it is necessary to modify minor details of the method for handling materials for each particular piece of work. Nevertheless, equipment of this kind can be more or less standardized so that it will serve repeatedly for the usual construction jobs.

Among the ways for devising runways is one shown by one



Wooden Bracket on Roof of Car Supporting a Runway

of the accompanying views which suggests that equipment for this purpose may be made standard and will serve for repeated use. The work train may be made up so that gravel and sand can be handled in a similar manner, thus avoiding the necessity of unloading and rehandling. With an outfit such as suggested, all expense of unloading, housing, and reloading to move to the next job, is eliminated. If more than one car of cement is required it simply becomes necessary to handle two, three, four or more cars in bulk in the train. As soon as the cars are empty they can be returned to regular traffic. The writer's experience in railway



A Work Train, Including Mixer and Material Cars Equipped for Handling Bulk Cement

engineering work convinces him that careful estimates would show that the usual accredited expense of keeping a car out of regular service and using it to house the cement during the period of time necessary to use a carload would be less than the cost of performing repeated loading, and reloading with the consequent loss of sacks and material unavoidable with sack shipments. This presumes, of course, that the job is one that will require at least a carload. Shelters provided on the job to protect cement must be taken down so that the lumber may be

moved and perhaps re-erected elsewhere for a similar purpose. In all of these operations some material is unavoidably destroyed which increases the expense, and each time the labor of erection and wrecking is a total loss.

Loading bulk cement at the mill is performed in a simple manner. A tight car such as would be used for grain, and fitted with grain doors, is required. In loading, a spout is set in place through one of the car door openings. The cement is measured by weighing with a device called a "weightometer," as it passes along the belt conveyor to the spout. This weighing is not the accepted weight under which the car is billed, as it is afterward

Unloading Material to Wheelbarrows Handled Over Double Gangways to Mixer Providing Runway in Each Direction

weighed over track scales, but until the "weightometer" was devised, it was necessary to shift the car several times to track scales in order to determine how nearly the desired loading had been attained.

Experience seems to have proved that bulk cement shipments are more likely to reach their destinations in good shape than sacked shipments. One would naturally expect the opposite to be the case, but the jolting of the car in transit causes the cement to settle down so that at destination the surface of the cement is smooth and level, and the material so compacted that a man can walk over it without sinking in above the soles of his shoes. The total shipments made in bulk by one large cement company dur-

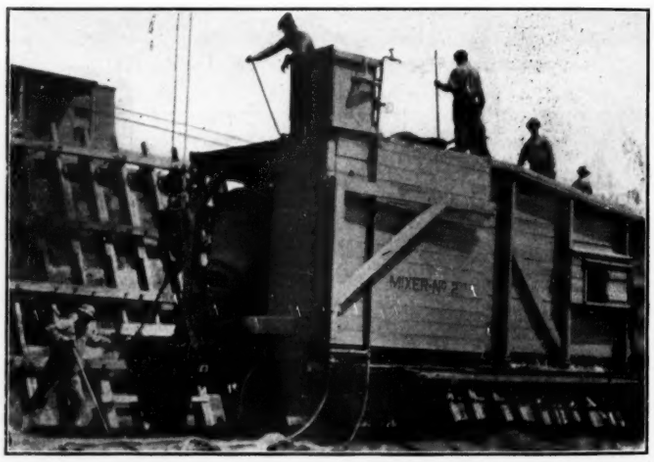
Dumping Bulk Cement Into a Hopper Over the Mixer Showing Absence of Dust

ing three years have involved only one damage claim and this was less than $5.

Several cases have been noted where cars with leaky roofs and loaded with bulk cement have passed through rainstorms with only trifling damage to the contents. Below the hole in the roof there is formed as a result of a leak a small lump of cement about the shape and size of a soup plate. When this has been removed the remainder of the cement is clean and ready for use. If sacked cement is exposed to leaks in the same manner, the rain will run over the surface of the sacks, flow down through spaces between them, possibly to the car floor, and damage a large quantity. One of the commonest causes of trouble with sacked shipments is from nails that work loose in the car floor or sides. It is absolutely impossible to prevent these nails from tearing sacks, so that frequently they are refused for redemption. There is also a considerable loss of cement from the torn sacks.

At first thought one would be inclined to think that the unloading and other handling of bulk cement would raise an objectionable amount of dust. As a matter of fact, there seems to be less dust than results from handling sacked cement. This may perhaps be explained by considering the porous nature of the cloth sack and realizing that there is a continual sifting of contents through it so that more dust results from dropping sacks on a truck than by allowing a shovelful of closely compacted bulk cement to slide into a wheelbarrow.

Two methods of unloading bulk cement that have proved entirely satisfactory are being used: First, shovels and wheelbarrows; and second, a power scoop such as is used for unloading grain. In most cases the shovel and wheelbarrow method will be found the simpler and more economical, although on jobs which are large enough to warrant the expense of additional equipment, the power scoop has shown remarkable efficiency. On one large job it was found that one man with the aid



The Mixer in a Bulk Cement Plant Discharging Into Placing Buckets, One Mix Every 45 Seconds or 220 Yards per 10 Hour Day

of a power scoop, could unload a carload of bulk cement in less than two hours. In this particular case the bulk cement was conveyed to an overhead bin by means of a bucket elevator, so that this man's work represented the entire labor cost of unloading and housing the cement.

Cement when compacted will stand up at an angle of about 90 deg., so that it is advisable that storage bin bottoms and chutes should have a pitch of 45 deg. On a great many construction jobs it will be found unnecessary to provide storage facilities for bulk cement, as it will be both practicable and convenient to use the cement out of the car as needed. When bulk cement must be stored, the ideal arrangement is the overhead bin from which the contents may be discharged by gravity. Where the overhead bin is not practicable, one may be constructed on the same level with the mixer from which the cement may be shoveled or drawn by means of a conveyor into the mixer hopper. Bin walls should be made strong enough to resist considerable side thrust. A safe way to figure the side thrust of loose cement is to estimate 20 lb. to the square foot for each foot of depth; in other words, if the cement is to be placed in a bin 3 ft. deep, the lowest side plank should be strong enough to withstand a pressure of 60 lb. per sq. ft.

Another objection which would naturally be advanced

against the use of bulk cement is the difficulty of measuring it, but those experienced in using it say they have not had any more difficulty in this regard, than in measuring sand, gravel or stone. It is very conservative to figure an average package loss and expense of 5 cents per barrel where cement is used in cloth sacks, or 10 cents per barrel where it is used in paper bags. People fail to realize that they are paying from 5 to 10 cents per barrel to have the cement measured for them.

There seems no reason why bulk cement should not be measured in wheelbarrows or boxes in exactly the same manner that sand, gravel and stone are measured. In the case of a 1:2:4 mix, for instance, measured in this way, any factor of error that may exist is likely to be constant in the case of all the materials, whereas if the cement is measured in sacks, the factor of error will be multiplied by two in the case of the sand and by four in the case of the stone. If greater refinement of measurement is desired, measuring boxes of different types may be used, or if exact measurements are wanted, the cement may be weighed.

Various methods of measuring that have been used on a number of the large jobs have proved that remarkable accuracy may be attained. On one job which the writer has in mind, concrete was mixed for a 1:3:6 mixture in two-bag packages. One man operating the wheelbarrow merely had to bring the wheelbarrow to the measuring box, dump the box and return to the mixer. The efficiency of the measuring device was shown by records made and kept by the foreman on the job. These were checked against the bill of lading and showed a discrepancy of only seven sacks per car, corresponding to an error of only 0.6 per cent.

Concrete products manufacturers, especially those engaged in the manufacture of block, tile, sewer pipe and fence posts, have found it decidedly advantageous to buy and handle their cement to and from storage bins in bulk. This suggests other possibilities for those railroads which are manufacturing fence posts in large quantities, who would, no doubt, find it a distinct economy to install storage bins and other necessary equipment to handle bulk cement at post manufacturing plants. One large machinery concern has devoted considerable attention to designing various equipment for handling bulk cement, but requirements are usually simple and anyone with the average knowledge of conveyor systems can no doubt devise means suited to his individual requirements.

MAKING RECORDS WITH LOADING MACHINES

By F. N. Loughnan

Division Engineer, Lehigh Valley, Wilkesbarre, Pa.

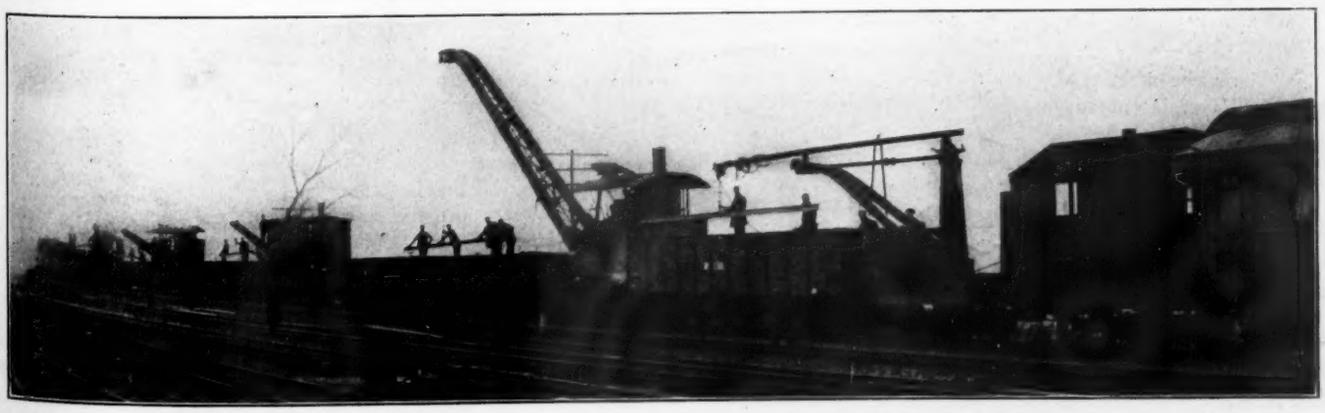
A work train made up of a locomotive and nine loading machines, each manned by an operator, a fireman and four laborers, loaded 115,817 ft. of 90-lb. relaying rail, or almost 11 track miles, on the main line of the Wyoming division of the Lehigh Valley on April 5, 1915. The rails were in a continuous stretch, were numbered consecutively, and were loaded into 37 cars, as they came out of the track in such a manner as to permit of their being unloaded and relaid in track in the same order.

All details of careful organization are attended to every time a work train is used on this road, and, at the same time, arrangements are made to prevent the slightest delay to traffic. Although in the case mentioned the day was Monday when there is no decrease in the usual number of trains operated over the division, there was not the slightest delay or interruption to traffic. The equipment, which included all sorts of loading machines, from a regular rail loader and a locomotive crane to a ditcher equipped for the purpose, started the work of loading at 6:30 in the morning and the last rail was placed on a car at 3:55 in the afternoon. The rails were shipped the same afternoon to the western end of the system, where they will be placed in use again.

The cost of loading and unloading track materials such as rails, switches, frogs, etc., has been greatly reduced by the substitution of mechanical power for manual labor. A work train on the Lehigh Valley ordinarily unloads from 70 to 128 cars of crossties daily while at work on the main line. In unloading and distributing new rail along its main line, picking up rail or unloading ashes, the results are just as interesting. Remarkable results have been obtained through the employment of as many rail loaders and other hoisting machines in one train as are available. The charges for train service are conspicuously reduced because with these machines and one engine as much material is handled in one day as could be done with a single machine in six or seven days.

The use of the work trains is under constant scrutiny. The burden is on the supervisor to show he has need for a work train and then he has the co-operation of all to get his work done as quickly and effectively as possible. The high wages paid engine and train crews have so considerably increased the cost of all work train service that every effort has been directed towards reducing the number of work trains employed and to the substitution of mechanical for manual labor wherever possible.

The largest number of new rails unloaded and distributed along the main line with one work train in a single day was 67,126 ft. of 100-lb. rail. Six machines were used in this case and 22 gondola cars were unloaded. By using two more machines it would have been possible to distribute and unload over 100,000 ft. of new rail in one day with the same work train service. In the work of unloading crossties and distributing them along the main line, 128 cars containing 28,094 ties have been unloaded in a single day. These ties were distributed along a supervisor's subdivision, ready to be used in renewals, and it is now contended that it will be possible to unload 150 cars of ties in a day under similar circumstances. With regard to unloading ashes, the contents of 125 coal cars



A Work Train on the Lehigh Valley with Six Rail Loading Machines

were unloaded on April 6, 1915, with one work train. Regarding the rail loading record mentioned at the beginning, it is believed it will be possible either to pick up or unload the rail for 15 miles of track in one day with one train when organization is further perfected and a few additional machines are available.

THE COMPARATIVE COST OF HANDLING EARTH ON FLAT AND AIR DUMP CARS

In excavating for the new passenger terminal and belt line at Kansas City it was necessary to remove over 2,000,000 cu. yd. of earth and rock. This material was handled on flat cars and on 12-yd. Western air dump cars. For two months, the cost of handling material with these two types of equipment was carefully compiled, and this data has recently become available for publication. During these two months the conditions under which the two kinds of equipment were employed were very similar, the material in each case consisting of at least 75 per cent solid rock. If conditions favored either type of equipment, the advantage was with the flat cars as the interference with traffic was greater at the dump when the air dump cars were used.

The following tabulation gives the relative cost of operation for the two months:

	Flats	Dumps
First Month		
Car repairs	$0.0706	$0.0011
Engines	.0821	.0235
Lidgerwood and airmen	.0052	.0067
Labor on cars	.0274	.0087
Labor on track	.0838	.0658
Eng. and super	.0043	.0043
Miscellaneous	.0102	.0031
Total per cu. yd.	$0.2836	$0.1132
Second Month		
Car repairs	$0.0698	$0.0070
Engine service	.0748	.0243
Lidgerwood and airmen	.0044	.0080
Labor on cars	.0337	.0077
Labor on track	.0926	.0570
Eng. and super	.0036	.0050
Miscellaneous	.0063	.0043
Total per cu. yd.	$0.2852	$0.1133

It will be noticed from the above that there was considerable difference in the cost of car repairs. In justice to the flat cars it should be said that the repairs shown for these two months exceeded the average cost up to that time by approximately 1½ ct. per cu. yd. The flat cars were of wooden construction with capacities of 60,000 lb. and 80,000 lb., and had been in constant service for 18 months at the time this information was collected. The dump cars were of steel frame construction, of 80,000-lb. capacity and had been in service five months.

The cost of engine service includes the rental of the engines and the pay of the crews from the time of their arrival to the time of the departure of the trains at the dump. A sufficient track force was always maintained to assure no delays to the trains waiting for the dump tracks to be put into condition. During the two months under consideration the unloading was done in yards exclusively, and for this reason the cost of engine service was not as great as later when the material was unloaded on the main tracks, which carried a traffic of approximately 150 trains per day in addition to many switching movements. Very little unloading was done on the main tracks by means of a Lidgerwood engine and plow because of the danger of delays both to the construction trains and to traffic. On the other hand trains of dump cars were frequently sent out to unload a few minutes ahead of passenger trains with only slight danger of delaying them.

The third item of cost, that for Lidgerwood and airmen, arose from the fact that it was found desirable to have a mechanic operate the Lidgerwood to reduce delays and for the same reason to have a mechanic with the air dump cars. In addition to taking care of the air valves and pipes, this man also made light repairs on the cars. The expense for labor on the cars was much greater on flat than on dump cars, especially during the winter months, as would be expected because of the difficulty of keeping the car floors and aprons clean to prevent the dirt from accumulating and freezing.

The cost of track labor was dependent more on the height of the fill and other conditions than on the type of equipment used. Where it was practicable to use only one track a saving in track labor was effected by the use of the dump cars as they could be unloaded more quickly and thereby cause less delay to the track laborers. Where two dumping tracks were available this difference did not exist.

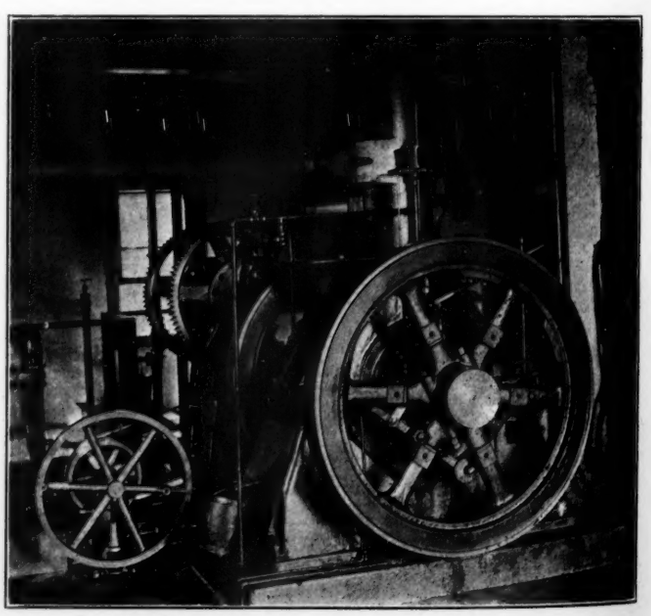
While the last two items in the tabulation do not depend on the type of equipment used, it was found that more emergencies arose from the use of flat cars with Lidgerwood unloaders and plows than from the use of dump cars. Also, it was found possible to unload at the end of a spur track on a fill successfully with dump cars, while this could not be done with flat cars and plows since the plow at the end of the train occupied a space of at least 20 ft.

This work was handled under the direction of, and the data compiled by E. P. Weatherly, formerly engineer maintenance of way, of the Kansas City Terminal Railway, under the general supervision of J. V. Hanna, chief engineer.

SERVICE OF A FUEL OIL ENGINE IN A RAILWAY PUMPING STATION

About 5,000,000 gal. of water per month is being pumped at the Nevada, Mo., pumping station of the Missouri Pacific at a cost of 1.73 cents per thousand gallons. This service, which is being performed by a fuel oil engine, is considered very satisfactory in comparison with the average rate at steam plants under similar conditions on this and other roads.

In order to obtain a reliable and satisfactory supply of water



The Fuel Oil Engine in the Missouri Pacific Pumping Station at Nevada, Mo.

for roundhouse purposes and for about 1,175 engines per month at this division point, which is the most important terminal on the Joplin division, it was necessary to locate the pumping station about four miles west of the engine house on the Marmaton river, and the abandoned pump house and grounds of the Nevada Water Company were acquired at a very reasonable cost. The plant consists of a 42 ft. by 48 ft. brick pump house, a three-room frame pumper's dwelling, 18,000 ft. of 8-in. discharge line, about 150 ft. of 10-in. suction line, a steel standpipe 24 ft. in diameter and 45 ft. high and two pumping units, each of approximately

400 gal. per min. capacity. A low storage dam has also been provided in the river. The total cost of these facilities was approximately $31,500.

The main pumping unit for regular use consists of a 40-hp. vertical single cylinder Crescent oil engine direct connected to a Deming single action triplex pump having cylinders 9 in. in diameter and a stroke of 10 in. The engine is equipped with a compressed air starting device. The water cylinders of the pump are located in a pit with their base 18 ft. 6 in. below the base of the power head or main floor level of the pump house. The discharge head from the center line of the suction pipe to the top of the steel tank is 164.4 ft. An auxiliary steam unit consisting of a 45-hp. vertical boiler and a 12 in. by 7 in. by 12 in. duplex pump was installed for emergency use.

The fuel oil used in the Crescent engine is low grade engine distillate of 32 deg. to 34 deg. Baume specific gravity. A storage tank 8 ft. in diameter and 28 ft. long is located underground outside of the pump house which provides a storage capacity for approximately 18 months' supply of oil at the present rate of consumption. A test of this fuel oil showed a consumption of 3.23 gal. per hour when the engine was making 300 r. p. m. against a pressure of 96 lb.

The operating expenses of this plant for six months were as follows:

3,250 gal. of fuel oil at 3c. a gal.	$97.50
144 gal. of lubricating oil at 17c. a gal.	24.48
110 gal. of coal oil at 3⅝c. a gal.	3.98
Labor maintaining	51.00
Minor repair parts	20.00
Salary of pumper	300.00
Total for six months	$496.96

During this time 28,680,000 gal. of water was pumped against a head of about 225 ft., including friction and suction, at the average rate per thousand gallons of 1.73 cents.

The operating cost of a steam plant at this point for the same six months is estimated as follows:

152 tons of coal at $2	$304.00
Hauling coal five miles at $1 per ton	152.00
Oil, waste and supplies	50.00
Repairs	100.00
Pumper's salary	300.00
Total for six months	$906.00

For the total quantity of water mentioned above, this would mean an average cost of 3.09 cents per thousand gallons. The comparative cost of installation of the fuel oil engine and the steam plant is estimated as follows:

40-hp. oil engine	$2,000.00	Boiler in place	$1,200.00
Pumps	600.00	Steam pump	600.00
Foundation	100.00	Foundation	200.00
Pipe and connections	200.00	Pipe and fittings	200.00
Labor	125.00	Labor	200.00
		Boiler feed	150.00
Total	$3,025.00	Heater	200.00
		Total	$2,750.00

ABSTRACT OF ENGINEERING ARTICLES

The following articles of special interest to engineers and maintenance of way men to which readers of this section may wish to refer have appeared in the *Railway Age Gazette* since May 21, 1915:

Preparing for the Federal Valuation of the Railways.—A description of the methods adopted by seven representative roads in preparing their information for the federal valuation parties now working on their lines was published in the issue of May 28, page 1107.

A Modern Concrete and Brick Roundhouse at DuBois, Pa.—The Buffalo, Rochester & Pittsburgh has recently completed a 16-stall roundhouse at DuBois, Pa., involving a number of interesting details of reinforced concrete construction. This building was described and illustrated in the issue of May 28, page 1110.

Fundamental Problems Involved in Railway Valuation.—A detailed report of the conference held in Washington attended by Director Prouty of the federal valuation board and his staff, and over 200 representatives of the railways and state commissions was published in our issue of June 4, page 1146.

Norfolk & Western Elkhorn Grade Electrification.—The Norfolk & Western is now completing the electrification of 30 miles of its main line between Bluefield, W. Va., and Vivian. This installation was described in detail in an illustrated article in the issue of June 4, page 1152. Additional details regarding traffic and operating conditions were discussed editorially in the issue of June 11, page 1230.

Report of the Chicago Railway Terminal Commission.—The recommendations made to the Chicago City Council Committee on Railway Terminals by the Chicago Railway Terminal Commission in a recent report were published in the issue of June 4, page 1163.

Lateral Stresses in Rails on Straight Track.—An extensive series of experiments carried on recently in the main track of a prominent road to determine the lateral stresses in rails on straight track under different conditions of line and surface, and with various types of locomotives running at different speeds, was described by George L. Fowler in an extensive illustrated article in the issue of June 11, page 1231.

Overhead Charges in Valuation.—In an article in the issue of June 11, page 1242, Richard Hoadley Tingley discussed the lack of agreement regarding the allowances generally made in valuation work and urged careful investigation to determine actual charges to this account.

BUFFALO ROCHESTER & PITTSBURGH STANDARD OUTFIT CARS

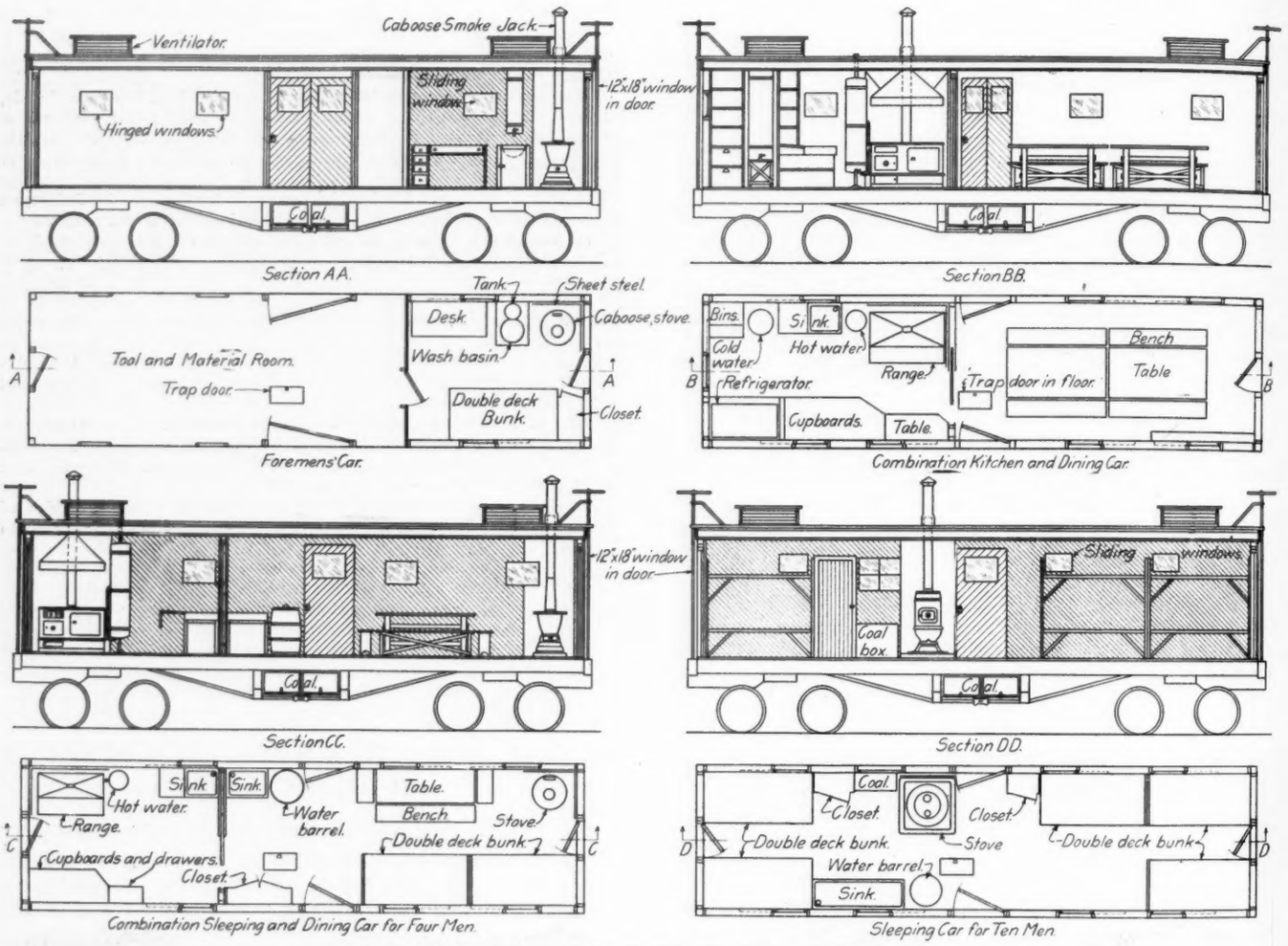
The Buffalo, Rochester & Pittsburgh provides unusually complete outfit cars for its bridge and building, mason, signal and water service gangs. The equipment for a small gang consists of a foreman's car and a combination dining and sleeping car, while that for larger gangs consists of a foreman's car, a combination kitchen and dining car and as many sleeping cars as are necessary to accommodate the gang. The interior of all cars except the tool and material room in the foreman's car is sealed on the sides and top with ⅞-in. T. & G. seasoned yellow pine over a layer of waterproof building paper. The regular car floor is covered with a 1¼-in. maple flooring laid on a layer of waterproof building paper. Par-

Exterior View of a Camp Outfit

ticular care is taken to secure tight joints and to properly flash around the ventilators and smoke jacks.

The standard foreman's car is divided into two compartments, the larger being used for the storage of material. Partitioned off at one end is the foreman's quarters, provided with a desk, a washstand and a double deck steel bunk. It is tected by sheet steel furred out from the wall and the ceiling. The opposite end of the car is provided with the customary benches and a dining table.

The combination sleeping and dining car is provided with a kitchen at one end and two double deck steel bunks along one wall and a 6-ft. table along the opposite wall in the other



Standard Outfit Cars of the Buffalo, Rochester & Pittsburgh

heated with an ordinary caboose stove placed in one corner.

The combination kitchen and dining car is divided into two compartments. The smaller one is devoted to the kitchen and contains a stove with a hood, a hot water tank, sink, cold water tank, refrigerator and various storage bins. The stove is placed on a concrete base and thoroughly secured to the floor. All walls and ceilings adjacent to these stoves are pro-

end. The standard sleeping car provides for five double deck steel bunks in the ends of the cars and a stove along one wall opposite the door in the center of the car.

A color board is placed on the outside at the upper right hand corner on each side of each car indicating the branch of the engineering department to which the car belongs. The organization of the B. R. & P. is departmental and all mainte-

Interior Views of the Cars

nance of way work is under the charge of the engineering department. Each branch of this department is assigned a standard color—the bridge and building yellow, mason black, track green, signal gray, water service blue, etc. All hand and push cars, feeders, tool boxes, tools, etc., are also painted with these distinctive colors to distinguish them and indicate their ownership.

STAFF MEETINGS FOR MAINTENANCE OF WAY EMPLOYEES

BY J. T. BOWSER

Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

Why should not the practice of holding staff meetings be extended to the maintenance of way department? Meetings attended by section and extra gang foremen and supervisors, presided over by the road master or division engineer cannot fail to be of considerable benefit to the department as a whole. It should not be a difficult matter to arrange for such meetings at stations centrally located, and the managements of many railroads would undoubtedly authorize an arrangement by which the expenses of men who have to be away from home would be paid by the company.

The division officer who is to preside at the meeting should prepare notes beforehand on subjects which he desires to discuss or explain. Such occasions offer excellent opportunities for outlining and explaining new practices, thus insuring their more intelligent application. When these matters have been disposed of the meeting can be thrown open to the men for the general discussion of any questions on which they may desire information. They should be encouraged to describe their methods and to comment on those described. New men should be encouraged to ask questions, and all complaints should be freely discussed and investigated.

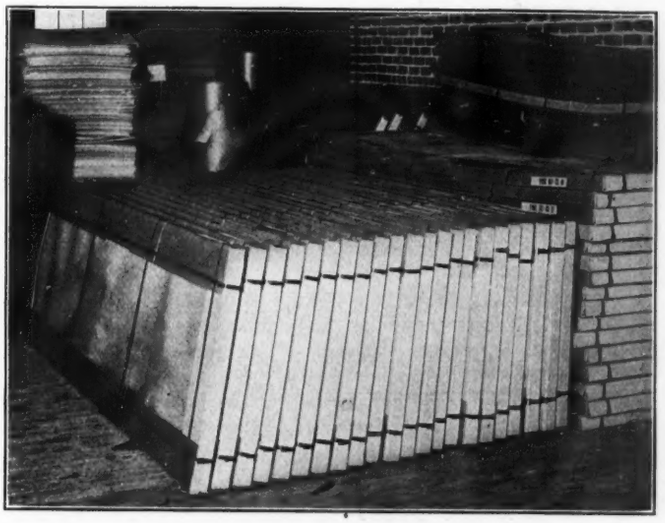
The men should be encouraged to make note of conditions involving the safety of employees or others, or in any matter in which the company's interests are involved. Any recommendation should be acknowledged and discussed and if not adopted, the reasons should be explained.

Such meetings, held three or four times a year, will wonderfully improve the spirit and personnel of the organization. The men will become acquainted with each other, with their supervisors and with the division officials. Their interest in their work and in all matters involving the company's interests will be greatly increased, while a general rise in the tone of the organization will be readily noticed. Men who have been in the rut of old methods for years will pick up ideas of improved methods, while the "hard headed" foreman, who cannot be taught or instructed in the usual manner, will assimilate ideas that he might never get otherwise.

A NEW TYPE OF WALL BOARD

The "Certain-teed" wall board recently placed on the market by the General Roofing Manufacturing Co., St. Louis, Mo., is made by cementing together four sheets of clean wood fibre material and is designed to secure great strength and resistance to moisture and dampness. Experiments were carried on for about four years in an endeavor to secure these qualities to the greatest possible extent, with the result that this material is shown by tests to have a strength of 424 lb. per sq. in., and that its absorption of water in a one-hour test is 70 per cent, and in a four-hour test, 98 per cent. While this material has been used satisfactorily for interior finish in many buildings, the object of the manufacturers has been to secure the best service rather than a beautiful finish.

This material is particularly adapted to railway buildings in which there is a considerable amount of vibration, where plaster is cracked and broken. In factories, shops and offices where revolving machinery or passing trains cause such vibration, the wall board can be satisfactorily used and in passenger stations it is more attractive and also more economical than some of the common methods of finishing the interior walls. The further advantages are claimed for it that it is a non-conductor of heat, therefore saving fuel in cold weather and keeping the building cooler in summer, and that it is clean, durable and sanitary. It can be calcimined, varnished



Bundles of "Certainteed" Wall Board Ready for Shipment

or painted with oil or water color paint, and can be applied more quickly and easily than laths and plaster.

This material is made in widths of 32 and 48 in., and in lengths varying from 6 to 16 ft. It weighs approximately 650 lb. per 1,000 sq. ft. It is packed in bundles containing 10 pieces each and protected by container board covering held in place by steel bands, enabling it to be handled readily.

WOOD PRESERVATION STATISTICS

The American Wood Preservers' Association in co-operation with the Forest Service, United States Department of Agriculture, has compiled and published statistics showing the quantities of wood preservatives consumed and the amount of wood treated in the United States in 1914. The following information is abstracted from this report:

In 1914 the Forest Service records showed 122 plants of all types, 100 of which were of the pressure-cylinder type. In Table I the consumption of wood preservatives used by the treating plants is shown by years, kinds of preservatives and quantities. For 1910, 1911 and 1912 the increase in the use of creosote oil was approximately 10,000,000 gal. annually. The greatest consumption of preservatives was recorded in 1913. In 1914 the total quantity of creosote oil reported dropped approximately 29,000,000 gal. This was due primarily to the facts, that the supply of creosote from England and Germany during 1914 decreased, and that for years prior to 1914 paving oil was included in the creosote statistics. In this report paving oil, reported as 9,429,444 gal., is listed separately.

TABLE I—CONSUMPTION OF WOOD-PRESERVATIVES BY THE TREATING PLANTS IN THE UNITED STATES, 1909-1914

Year	Number of Plants	Creosote, Gallons	Zinc chloride, Pounds	Other preservatives, Gallons*
1909.....	64	51,431,212	16,215,107	.....
1910.....	71	63,266,271	16,802,532	2,333,707
1911.....	80	73,027,335	16,359,797	1,000,000
1912.....	84	83,666,490	20,751,711	3,072,462
1913.....	93	108,373,359	26,466,803	2,885,738
1914.....	94	79,334,606	27,212,259	9,429,444† / 2,486,637

*Includes crude oil, coke oven-tar, refined coal-tar, and carbolineum oils.
†"Paving oil."

The total consumption of zinc chloride in 1914 exceeded the 1913 figures by approximately 750,000 lb.

Some firms have experienced considerable difficulty in obtaining foreign oil, very largely due to inability to obtain tank steamers for its transportation. Some of the larger manufacturers of creosote oil in the United States estimate that the production of the American oil has been increased by 25 per cent, owing to the installation of new coke ovens. However, many of the coke ovens which manufacture the crude coal-tar have not been operating; consequently this increased production has not been felt materially to date. The difference in the totals of creosote oil consumed for 1913 and 1914 was nearly equally distributed between the foreign manufacturers and the American producers of this commodity.

TABLE II—RELATIVE QUANTITIES OF DOMESTIC AND IMPORTED CREOSOTE USED IN THE UNITED STATES, 1909-1914

Year.	Total creosote used, Gallons	Domestic creosote, Gallons	Per cent of total	Imported creosote, Gallons	Per cent of total
1909.....	51,426,212	13,862,171	27	37,569,041	73
1910.....	63,266,271	18,184,355	29	45,081,916	71
1911.....	73,027,335	21,510,629	29	51,516,706	71
1912.....	83,666,490	31,135,195	37	52,531,295	63
1913.....	108,373,359	41,700,167	38	66,673,192	62
1914.....	79,334,606	28,026,870	35	51,307,736	65

The price of domestic creosote in 1914 averaged in the neighborhood of 8 cents to 8½ cents per gallon, f. o. b. plant. Very few quotations for creosote are being given for 1915 delivery, but, owing to the scarcity of oil, prices for 1915 probably will be somewhat higher. Much the same condition exists in the production of zinc chloride, owing to the inability to obtain spelter. However, some firms are buying their supplies of this preservative at very slight increase over the figures current in 1914.

Increased amounts of creosote oil may have to be produced in the United States in the future owing to the perfection in Europe of engines using such oil as a fuel. Also in European countries increasing amounts of tar are being used for road making, and as tar is distilled for commercial creosote the tendency is to reduce the quantity of creosote oil manufactured in Europe for preservation purposes. Considerable progress has been made in this country on some plants located in the Middle West, which when completed, will add 10,000,000 or more gallons annually to the supply of domestic creosote.

The number of ties treated in 1914 exceeded the total in 1913 by 3,577,571. The hewed ties treated comprised about 70 per cent of the total or 30,222,183, while 13,624,804 were sawed. A few companies treated more hewed ties in 1914 than in 1913, owing to the fact that more tie cutters were available during 1914 than in the preceding year. Nevertheless, the increase in the total number of cross ties treated is reflected chiefly in sawed ties. Oak ties lead in the number treated. Over 39,000,000 ties were treated by creosote and zinc chloride, approximately one-half of the total being reported under each class. Over 50 per cent of the ties treated with zinc chloride were oak. The most common treatment of pine was made with creosote, and 1,159,929 ties of the total of 1,956,278 treated with zinc and creosote emulsion were oak. Zinc creosote emulsion was used for treating 1,956,278 cross ties; 2,625,681 ties were impregnated with miscellaneous preservatives, including crude oil, paving oil, refined coal-tar and oils reported as carbolineum. The treatment varied from dipping in open tanks, as practiced by some traction lines, to heavy penetration of 10 to 12 lb. of oil per cubic foot by steam railroads. Approximately 135,000,000 ties are purchased annually by railroads, and although much progress has been made in tie treatment to date, but 43,846,987 ties are run through cylinders.

TABLE III—NUMBER OF CROSS TIES TREATED, BY KINDS OF WOOD AND KINDS OF PRESERVATIVES, IN 1914

Preservative	Oak	Yellow Pine	Douglas Fir	Western Pine	Beech	Gum	Tamarack	Maple	Birch	Elm	Other species	Total
Creosote	6,537,857	7,102,396	5,452,516	712,631	572,828	255,672	183,044	419,535	126,735	1,972	1,226,257	22,591,443
Zinc Chloride	8,549,073	1,866,627	2,221,163	1,656,721	352,415	536,267	340,462	132,644	.....	41,358	976,855	16,673,585
Zinc Chloride and Creosote	1,159,929	111,998	.....	.....	114,466	32,091	.....	28,728	.....	.....	509,066	1,956,278
Miscellaneous	148,275	1,526,243	57,085	.....	.....	86,833	290,424	.....	208,700	.....	308,121	2,625,681
Total	16,395,134	10,607,264	7,730,764	2,369,764	1,039,709	910,863	813,930	580,907	335,435	43,330	3,020,299	43,846,987
Per cent of each kind of total number treated	37.39	24.19	17.63	5.40	2.37	2.08	1.86	1.32	.77	.10	6.89	100

TABLE IV—COMPARATIVE STATEMENT OF MATERIAL TREATED IN THE UNITED STATES, 1909-1914

Preservative	Year	Cross ties, cubic ft.	Piling, cubic ft.	Poles, cubic ft.	Paving blocks, cubic ft.	Construction timbers, cubic ft.	Cross-arms, cubic ft.	Lumber and miscellaneous, cubic ft.	Total material treated each year, cubic ft.
Creosote	1909	29,830,080	4,421,726	659,664	2,994,290	4,902,311	41,764	417,787	43,267,622
	1910	44,525,229	5,219,254	255,597	4,692,453	7,801,272	88,069	2,687,713	65,269,587
	1911	49,532,163	4,937,363	106,213	10,145,724	7,417,105	71,961	2,499,995	74,710,524
	1912	57,461,515	7,624,939	1,169,981	7,091,658	6,892,493	1,643,128	2,841,195	84,724,909
	1913	75,998,307	7,630,328	2,367,769	6,810,308	10,308,883	1,813,010	1,853,993	106,782,598
	1914	67,774,329	7,804,657	1,188,511	3,127,506	8,389,158	395,403	1,348,566	90,027,630
Zinc Chloride	1909	24,153,162	.....	.....	.....	320,891	.....	2,333	24,476,386
	1910	27,587,583	.....	.....	.....	541,514	.....	71,060	28,200,157
	1911	28,337,883	.....	.....	.....	1,043,851	.....	119,931	29,501,665
	1912	28,532,874	.....	18,246	.....	259,972	.....	20,092	28,831,184
	1913	36,051,816	.....	47,996	.....	585,756	.....	7,670	36,693,238
	1914	50,020,755	.....	.....	.....	1,317,925	.....	4,355	51,343,035
Zinc Creosote	1909	8,095,794	.....	.....	.....	62,918	.....	43,699	8,202,411
	1910	6,354,219	38,392	.....	.....	181,143	.....	30,646	6,604,400
	1911	7,312,374	.....	.....	.....	.....	.....	.....	7,312,374
	1912	8,214,303	97,874	.....	.....	560,613	.....	99,367	8,972,157
	1913	6,938,838	327,594	.....	.....	758,989	.....	53,628	8,079,049
	1914	5,868,834	.....	.....	.....	140,718	.....	.....	6,009,552
All Preservatives	1909	62,079,036	4,421,726	659,664	2,994,290	5,286,120	41,764	463,819	75,946,419
	1910	78,467,031	5,257,646	255,597	4,692,453	8,523,929	88,069	2,789,419	100,074,144
	1911	85,182,420	4,937,363	106,213	10,145,724	8,460,956	71,961	2,619,926	111,524,563
	1912	97,183,009	7,737,035	1,188,579	7,397,095	7,793,524	1,643,128	2,988,686	125,931,056
	1913	120,781,248	7,957,922	2,500,420	6 856,293	11,653,628	1,824,719	2,039,658	153,613,888
	1914	131,540,961	8,061,902	1,482,407	6,869,370	9,847,801	417,914	1,362,284	159,582,639

CONVERTING FACTORS

To obtain the number of cross ties, divide figures shown by 3.

To obtain the number of lineal feet of piling, divide the figures shown by .6763.

To obtain the number of lineal feet of poles, divide the figures shown by .5868.

To obtain the number of square yards of paving blocks, divide the figures shown by 2.625.

To obtain the number of board feet of construction timbers, divide the figures shown by .0833.

To obtain the number of cross-arms, divide the figures shown by .6198.

To obtain the number of board feet of lumber and miscellaneous material, divide the figures shown by .0833.

CORRUGATION OF RAILS IN ELECTRIC RAILWAY SERVICE

In a paper delivered before the Institution of Civil Engineers of England by William Willox, on Rail Steels for Electric Railways, there appeared considerable information on the corrugation of rails in electrified steam railway tracks. The electrification of existing railways in England was begun in 1903, and the running of electric trains commenced in 1905. Apparently it was not foreseen that this would have other than the usual effect on the running rails, but it is now evident that electric trains, more especially, perhaps, in London, have reduced the life of the rails in a marked degree. This is due not so much to the fact that the trains are driven electrically as to the design of the motors used. The motors are therefore placed under the floors of the cars, except where electric locomotives are used to haul ordinary equipment. In the former case great difficulty has been encountered in carrying the motors on springs, and they are slung on the axles and so become a dead load, or nearly so. Besides this, the wheels are of small diameter, the trucks are short, the drive is near the extremities of the axles, and after a short period of service where there are curves, the wheels are in many cases of unequal diameter. The result on the road is very marked, the life of the rails being reduced by years. On part of the Metropolitan Railway where electric traction is in use the life of the rails in the open is only about 8 years and in the tunnel section barely 3 years. As the traffic increases, even this life cannot be maintained unless more durable rails than those ordinarily used are substituted. The 3 years' life for the tunnel section is the average, and on curves the life is much shorter.

The first trouble met with under electric traction was side wear, which was excessive on curves and occurred not only there but also on tangents, owing no doubt to the nosing of the motor cars. In order to prevent this on sharp curves inside guard rails were provided. These guard rails lasted only 3 to 6 months and it was necessary to keep a gang at work on renewals continuously. The difficulty has been entirely overcome on the Metropolitan Railway by the use of a special hard guard rail of such a shape as to prevent it from being put into the running rails by mistake.

The second, and a much worse trouble, is the grinding of the running surface of the running rail into hollows, called locally "battering," which is not corrugation but something much more than that. It occurs chiefly on curves. The hollows are nearly always just at the sides of the chairs towards approaching trains, the portion of the rail between consecutive chairs being hardly affected. It would thus seem that where the rail has spring the grinding is much less. The battering is apparently caused by the hammering action of the unspring-borne load of the motors on the rails; by skidding action along the rail, arising from the direct drive on the axle and by skidding action across the rail, arising from the rebound of the rail when it has reached its limit of side spring, caused by the pushing of the wheels as they go round the curve. Ordinary corrugation, such as occurs in street car rails, exists in all sorts of places near stations and between stations, but it has no serious effect, except probably to increase the noise of trains. It is this battering that so seriously lessens the life of the rails, especially on curves.

Because of this experience of the English railways, inquiry was made of Dr. P. H. Dudley, consulting engineer, New York Central Lines, regarding the extent to which this same effect had been noticed on the electrified portions of his lines. We quote from his reply as follows:

"I do not know of any corrugation in our rails, either on the Hudson or Harlem branch operated by electric traction. The rails used for electric traction on the New York Central are either our 6 in. 100-lb. or 105-lb. sections. The breadth of the head at its extreme width is 3 in., with sides inclined 1/16 in. per inch of height, and with 5/16 in. radii for the upper corners. The top radius of the rail is 14 in. This is a broad flat top rail, quite different from the T or doubleheaded section used in England, and I have not noticed any corrugations whatever on rails which have been put in service the last 3 or 4 years. When electric traction was installed with electric motors to draw the former steam cars, it was noticed in one or two places that there was a slight evidence of a sway and a small increase of wear at recurring positions on a few rails, but this has practically disappeared on more recent rails.

"There are two types of corrugations—long and short waves, which must be discussed in electric traction. The first I have partially described, and it no longer appears on our recent rails, while I have never noticed the short waves upon our stiff, broad, flat-topped rails.

"So far as I have observed in this country and in England the method of blooming the ingots is quite different in the ragging of the rolls. We use ragging with one sharp angle, but the other is inclined, while in England the ragging or cogging, as they term it, is done by square projections on the rolls. That type of ragging seems to effect the metal in the passes to an extent by its irregular pressure which is not completely overcome in the final rolling. The heads of the T or doubleheaded section have a smaller top radius with greater corner radii, consequently the actual bearing surface between the rail head and the wheel tread is smaller than in our practice, and corrugations can more readily occur.

"The long waves are due to a repeated oscillation of the equipment over the rails. The short waves produce shorter corrugations, and are noticeable for practically every inch or two in the rail top. I have never observed the latter type on our own rails, but I have seen this type to a slight extent upon rails of a different section of shorter top radius and greater corner radii."

DIFFICULTIES IN INCREASING THE SCOPE OF THE SECTION FOREMAN'S DUTIES

BY J. P. COSTELLO

Roadmaster, Atchison, Topeka & Santa Fe, Pueblo, Col.

In a recent issue an article appeared setting forth the economic value of increasing the duties of section foremen to take care of light repairs to bridges, buildings, signals, etc., the main objects being to make repairs quickly and to save the expense of the time lost by workmen moving on trains to and from the scene of the work. I grant that it is unfortunate that, under present arrangements, men cannot be on the ground to make these needed repairs, but the question arises, can the section forces do this work and if they can, will they, by so doing, increase the efficiency of the maintenance of way organization?

In order to save time, special tools and materials for these additional jobs would have to be kept on hand at all times on each section even though some of them would probably only be used on comparatively rare occasions. Although the allotments of tools and materials were small and restricted, their summation would certainly exceed the requirements of one or two special gangs at some central point. There would also be a greater chance of lost, misplaced, or misused tools and materials.

A man accustomed to the use of a claw bar, spike maul, or wrench cannot turn his hand to the use of carpenters' tools with any more readiness than a carpenter can turn from his own tools to those in use by the track department. Neither can a track foreman apply his mind to carpentry or signal work with the precision which he applies to his own class of work. Certain jobs might not present themselves as often as once in a year on an ordinary section. No man can do a piece of work with finished skill the first time it presents itself nor can he do it with real skill if it presents itself only after long intervals of time. The efficiency of a laborer depends upon his skill and skill is the result of experience—practice.

I have seen a statement that railway maintenance forces were less than 40 per cent efficient. I will not argue that this statement is inaccurate and I do not deny that the track forces contribute their share, at least, to this inefficiency. The discussion of increased duties for section foremen is no doubt the result of an attempt to overcome this inefficiency, but why should we expect to increase the efficiency of the whole department of maintenance by requiring more diversified work of one branch of that department? A study of some of our highly efficient factory organizations would indicate that the fundamental idea is to keep certain men engaged at one definite class of work.

Of course, in an organization like that of railway maintenance, where rather small units of the organization are maintained not directly under the eye of a supervising official, the attempt to make the work too machine-like would be a failure. A study of work which is essentially manual in character cannot be considered in the light of an exact science because we have the human element, interest, to deal with. Track work properly conducted and in a state of *evident progress* is interesting, otherwise we would not be able to secure men to handle it and at the same time accept with a degree of cheerfulness the rigors of the occupation.

I am convinced that the duties of section men are far too diversified now—too much energy dissipated in discontinuing one task to take up another. Their duties extend from menial tasks to important ones chargeable to other branches of the service. I agree that many of these things, under present conditions, must be performed by section men for the simple reason that no other provision is made to take care of them.

I have in mind a district which terminated at the end of a bridge over which only a restricted car tonnage was permissible, causing many heavily loaded cars either to be transferred or lightened. At another point were several mines at which cars were frequently damaged and had to be repaired —many times after they had been loaded. At another, a junction point, there was some sort of an agreement or arrangement about interchange of l. c. l. shipments whereby much unloading and concentrating of freight was necessary. The three sections whose headquarters were at these points were very unsatisfactory to handle, because at irregular intervals the heavy work of freight handling was thrown upon the section men and, of course, had to be done regardless of track work. It was impossible to get any systematic "line up" on the work or to arrange any definite program. These sections were always short of men and I am satisfied that this outside work had a greater influence on this shortage than the smallness of the wages which they received. Men engaged in any class of constructive or repair work, no matter what their nationality, intelligence, or education, must be able to see consistent progress in their essential work or they will not be interested. I believe everyone agrees that the *essential work* of section men is track work.

Engineers in charge of maintenance have usually figured that, by increasing the size of a gang at a point where outside work interfered, the same results in track work could be secured as by using a proportionately smaller gang engaged solely in track work. This idea is absolutely wrong. Work accumulates a certain momentum as it progresses. Every interruption or change of work dissipates this momentum—hence, loss of efficiency.

I have observed a couple of roads where the section men were required to wash the windows, scrub the floors and clean the outhouses of local stations. I have observed another road where this was not the rule. I have noticed, in the latter case, that the agent took a little personal pride in keeping his windows clean; that he discouraged the loafers and tobacco spitters, and that he kept his outside toilets locked. With the exception of a very few cases, I have never seen it to fail where section men could be called in to do odd jobs that they were imposed upon.

This new scheme of increased efficiency in maintenance is as much in error as many others for the reason that the idea is to accomplish the same results as formerly by the expenditure of less money. Present conditions require better track and the future will require still better and better track conditions. Why not aid the section foreman to increased efficiency and then encourage him by allowing him to see the results of his efforts?

Although seasonal in character, section work submits to a fairly definite program and by arranging such a schedule better results can be secured as to quantity and quality of work obtained. Increased efficiency will be the result of a definite program, while diversified duties interfere with the carrying out of a definite program of work.

As to the smaller repair jobs, aside from track work, which might be assigned to the section men, these could be better taken care of by special branches of the maintenance department if a definite program of repairs were carried out and I have noticed that, where such a program obtains, the small apparent defects vary inversely as the perfection of the program. The "window-pane" illustration is not a fair one because it refers to a fragile material and a condition of failure which is sudden and not of a progressive nature. Certainly no one would expect a local station to get along with a broken window for several months until the regular time in the program arrived to take care of it. In the proposed scheme, the idea would be to take care of such things as the loose hinge on the station door; the few decayed planks in the freight house platform; the loose shingles on the roof of the pump house; the corroded or broken bond wires at some street crossing; a water accumulation in the pipe lines of the crossing gates; or the thousand and one things which go wrong but which do not arise in a second. The stitch in time idea is all right, but we should not allow our faith in it to degenerate into the belief that repairs should be made in the barest scratch of time necessary to avoid the failure of a device.

Among men who have not handled track work directly the idea seems to prevail that the scheme of section work is for the foreman to find or to have pointed out to him something which needs attention and fix it, then go to some other point and do the same thing and so on. If this idea continues prevalent among the men who influence track work, section work will never be done with efficiency. Section work properly conducted aims at the general prevailing condition. I am satisfied that the present day inefficiency is not due entirely to the class of labor employed.

The position of section foreman is different from most other minor railway positions for the reason that when a man is made foreman in charge of a piece of track, his relationship to that piece of track borders on ownership. He may, at times, work for days or even weeks without conversing with his superior. Unlike other men he is free from intimate directions or regulations. If he is the right kind of a man and if he is not overwhelmed with a multitude of duties he takes a certain pride in the upkeep of the property turned over to him. On the other hand, if he has more duties than he can attend to properly, his attitude becomes that of a property-poor landlord.

To increase efficiency in the maintenance of way department the various branches of the department should be improved. If we condense the section work into the most essential things to be obtained, if we "programize" the work to take care of these essentials at the proper time, if the section men are allowed to carry out each part of their program with a minimum of outside interruptions and if the work be conducted so that the foreman and his men can see actual, positive progress, the increased efficiency of the section gangs will prove that they do not need additional duties. Such a policy should have the support of the highest officials who influence maintenance work.

General News Department

The Pennsylvania Railroad has received word from the Panama-Pacific International Exposition at San Francisco that the company has been awarded the grand prize, the highest honor which could be conferred upon any railroad exhibiting.

Southern Pacific passenger train No. 22, running from San Francisco to Los Angeles, was held up late on the night of June 11, near Chatsworth, Cal., by two masked men who went through the last four cars and robbed a number of passengers. The robbers then stopped the train and escaped.

Miss Irma Pratt, a member of the graduating class of the St. Clairsville (Ohio) high school, who lives at Barton, and has traveled back and forth on the Baltimore & Ohio, 6 miles each day, reports that she did this for five years without ever missing a day or a fractional part of a day of school, and without being tardy.

The Magnolia cut-off of the Baltimore & Ohio, which was opened for traffic last December, has effected an average reduction of 2 hours and 5 minutes in the time of train crews over the east end of the Cumberland division. The Magnolia cut-off, shortening the main line about 6 miles and giving more favorable grades, was described in the *Railway Age Gazette* of April 30, 1915.

The railroad department of the Young Men's Christian Association is establishing a railroad school in its recently completed college for the training of secretaries at Chicago. This course will be under the direction of leading railroad Y. M. C. A. secretaries, with W. N. Northcott, executive secretary of the railroad associations of Chicago, as dean. The purpose of the course is to train men to become efficient secretaries of railroad branches. This department of the school will begin its work next October.

For forty-five days the wreck train assigned to the east end of the Cumberland division of the Baltimore & Ohio was not called out in the territory between Cumberland and Brunswick, which embraces a distance of 102 miles of three-track and four-track railroad for a greater part of its length, and includes the Magnolia cut-off. This section of the Baltimore & Ohio is one of the busiest railroads in the United States.

Railway Sanitation

This is the title of a pamphlet which has been printed by the Baltimore & Ohio for circulation among employees in all departments of the service for the general benefit. It consists of five articles on the subject by Dr. E. M. Parlett, re-printed from the Baltimore & Ohio Employees' Magazine. Dr. Parlett is a member of the General Safety Committee of the road. These essays include one dealing in detail with the sanitation of construction camps, and another on typhoid fever and its conquest.

Results of Safety-First Work on Norfolk & Western

C. H. Blakemore, chairman of the safety commission of the Norfolk & Western, has issued a bulletin showing the decrease in injuries to employees during the 20 months ending December 31, 1914, since the safety movement was inaugurated on this road. The improvement with relation to the number of employees is shown on a chart on which is plotted a line showing the number of injuries and a line showing the fluctuations in the pay roll. The total pay roll and the total number of injuries as of May, 1913, is taken as a base line for making comparisons, and with relation to this line from August, 1913 (the high point, with 463 accidents), to December, 1914, with 172 accidents, there was a decline of 70 per cent. From May, 1913, the lines showing pay roll and injuries gradually diverge and at the end of 1913 the pay roll had declined 7 per cent, while accidents had gone down 25 per cent. At the end of 1914 the pay roll had declined to 17 per cent below the base line, while accidents had gone down 58 per cent, a further gain in accident reduction of 41 per cent. When the safety movement was inaugurated one employee on the line was being injured for each $3,600 of pay roll. For December, 1914, one employee was injured for each $7,000 of pay roll.

Economy in Distribution of Time-Tables

[From New York Central Bulletin]

It has probably never occurred to many agents how easy it is to throw away the company's money in handfuls by a wasteful distribution of time-tables.

An agent in an up-state village sent in a requisition for 300 copies form 1001, our General Folder, and 500 form 110, our Adirondack Division folder. We consulted our records and found that this station used about 5 form 1001 and 15 form 110 per month. As the first form costs about 1 cent a copy and the latter ½ cent, this agent would have received $5.50 worth of time-tables, when 25 cents worth would have answered his purpose until the summer schedule becomes effective two months hence. At a larger station, 2,000 copies of form 1001 were ordered. We found that this agent had used but 500 of this form in the past seven months. Bearing in mind the summer change in time 150 copies were ample to meet this requirement and that quantity was sent. If the full quantity requested had been shipped, he would have thrown away $18.50.

You are probably saying that these cases are exceptional. Nothing of the kind. They are every-day occurrences.

Stop and consider that the New York Central is supplying over 2,000 stations monthly with 25 different forms of time-tables, costing from 1 mill to 1 cent each in quantities ranging from 5 to 5,000 copies.

Order enough folders for one month only.

Street Railway Strike in Chicago

The 14,000 motormen and conductors employed on the Chicago surface and elevated lines went on strike at midnight on Sunday last, after the management of the companies had refused their demands for increases in pay and changes in working conditions. The three-year contract between the companies and the Amalgamated Association of Street and Electric Railway Employees of America expired on May 31, and negotiations on the new demands of the men have been in progress for some time. The employees for a long time refused to consider arbitration, and after the mayor of Chicago had held conferences with the officers of the union and of the companies in the effort to bring about an agreement, they proposed a plan of arbitration providing for a guarantee in advance of certain changes in working conditions which the companies declared would amount to an increase in pay of over $1,000,000 a year, while other questions were to be submitted to a board of arbitration composed of one man selected by the union, one by the companies and a third to be selected from a list of five names proposed by the union. The companies declined to agree to this kind of an arbitration and proposed that each side should select an arbitrator and that the two thus selected should choose the third. The company agreed to ask for no reductions in pay. This proposition was declined by the union leaders.

The surface lines made no attempt to run cars on Monday or Tuesday. The elevated lines ran a few trains on Monday without attempting to carry passengers, but on Tuesday attempted to give some service. As a result the steam railroads which normally bring in only a small percentage of the daily current of commuters, were confronted on Monday with an unusual traffic problem, with only a few hours to prepare for it. The railroads that ordinarily operate suburban service put every available car into that service, lengthening the regular trains and putting on as many additional trains as they could handle; and railroads that do not ordinarily run suburban trains put on extras and carried as many people as they could. The Illinois Central, the Chicago & North Western and the Chicago, Rock Island & Pacific, which carry the bulk of the suburban passengers into and out of Chicago, were taxed to the limit of their capacity on Monday, but on Tuesday

had organized the service so that it was handled with less confusion. The ticket selling facilities proved entirely inadequate, and it was found necessary to install many emergency ticket booths; and the cars were so crowded that the conductors missed a large percentage of the fares. On some roads the schedules were practically abandoned and trains were run one after the other as fast as they could be made up, in many instances with passengers hanging onto the engines and the roofs of cars. Emergency stations were established at various points where trains ordinarily do not stop. While there was a great deal of crowding and delay the inconveniences were generally accepted by the public good naturedly.

Many of the large stores and other business houses organized automobile or wagon service for their employees, and every available vehicle of any character was pressed into service to handle the crowds.

On Wednesday morning the officers of the companies and the representatives of the strikers agreed to arbitration, the third arbitrator to be Mayor Thompson.

MEETINGS AND CONVENTIONS

The following list gives the names of secretaries, dates of next or regular meetings, and places of meeting of those associations which will meet during the next three months. The full list of meetings and conventions is published only in the first issue of the Railway Age Gazette for each month.

American Association of Demurrage Officers.—F. A. Pontious, 455 Grand Central Station, Chicago. Next meeting, July 21, 1915, Milwaukee, Wis.

American Association of Railroad Superintendents.—E. H. Harman, Room 101, Union Station, St. Louis, Mo. Next meeting, August 19-20, 1915, San Francisco, Cal.

American Railroad Master Tinners, Coppersmiths and Pipefitters' Association.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago. Annual meeting, July 13-16, 1915, Hotel Sherman, Chicago.

American Railway Tool Foremen's Association.—Owen D. Kinsey, Illinois Central, Chicago. Annual meeting, July 19-21, 1915, Hotel Sherman, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Annual meeting, June 22-26, 1915, Hotel Traymore, Atlantic City, N. J.

American Society of Civil Engineers.—Chas. Warren Hunt, 220 W. 57th St., New York. Regular meetings, 1st and 3d Wednesday in month, except July and August, 220 W. 57th St., New York.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. 39th St., New York. Next spring meeting, June 22-25, 1915, Buffalo, N. Y. Annual meeting, December 7-10, 1915, New York.

Association of Railway Electrical Engineers.—Jos. A. Andreucetti, C. & N. W., Room 411, C. & N. W. Sta., Chicago. Semi-annual meeting with Master Car Builders' and Master Mechanics' Associations. Annual meeting, October, 1915.

Association of Railway Telegraph Superintendents.—P. W. Drew, Soo Line, 112 West Adams St., Chicago. Annual meeting, June 22-25, 1915, Rochester, N. Y.

Association of Transportation and Car Accounting Officers.—G. P. Conard, 75 Church St., New York. Next meeting, June 22-23, Niagara Falls, N. Y.

Engineers' Society of Western Pennsylvania.—Elmer K. Hiles, 2511 Oliver Bldg., Pittsburgh, Pa. Regular meetings, 1st and 3d Tuesday of each month, Pittsburgh.

Freight Claim Association.—Warren P. Taylor, Traffic Manager, R. F. & P., Richmond, Va. Annual meeting, June 16, 1915, Chicago.

General Superintendents' Association of Chicago.—A. M. Hunter, 321 Grand Central Station, Chicago. Regular meetings, Wednesday, preceding 3d Thursday in month, Room 1856, Transportation Bldg., Chicago.

International Railway General Foremen's Association.—Wm. Hall, 1126 W. Broadway, Winona, Minn. Next convention, July 13-16, 1915, Sherman House, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, C. H. & D., Lima, Ohio. Annual meeting, August 17, 1915, Philadelphia, Pa.

Niagara Frontier Car Men's Association.—E. N. Frankenberger, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, 3d Wednesday in month, New York Telephone Bldg., Buffalo, N. Y.

Peoria Association of Railroad Officers.—M. W. Rotchford, 410 Masonic Temple Bldg., Peoria, Ill. Regular meetings, 3d Thursday in month, Jefferson Hotel, Peoria.

Railroad Club of Kansas City.—Claude Manlove, 1008 Walnut St., Kansas City, Mo. Regular meetings, 3d Saturday in month, Kansas City.

Railway Telegraph and Telephone Appliance Association.—G. A. Nelson, 50 Church St., New York. Meetings with Association of Railway Telegraph Superintendents.

Salt Lake Transportation Club.—R. E. Rowland, David Keith Bldg., Salt Lake City, Utah. Regular meetings, 1st Saturday of each month, Salt Lake City.

Southern Association of Car Service Officers.—E. W. Sandwich, A. & W. P. R. R., Atlanta, Ga. Next meeting, July 15, 1915, Atlanta. Annual meeting, January, 1916.

Southern & Southwestern Railway Club.—A. J. Merrill, Grant Bldg., Atlanta, Ga. Regular meetings, 3d Thursday, January, March, May, July, September, November, 10 A. M., Piedmont Hotel, Atlanta.

Toledo Transportation Club.—Harry S. Fox, Toledo, Ohio. Regular meetings, 1st Saturday in month, Boody House, Toledo.

Traffic Club of Chicago.—W. H. Wharton, La Salle Hotel, Chicago.

Traffic Club of Pittsburgh.—D. L. Wells, Genl. Agt., Erie R. R., 1924 Oliver Bldg., Pittsburgh, Pa. Meetings bi-monthly, Pittsburgh. Annual meeting, 2d Monday in June.

Train Dispatchers' Association of America.—J. F. Mackie, 7122 Stewart Ave., Chicago. Annual meeting, June 15, 1915, Minneapolis, Minn.

Transportation Club of Detroit.—W. R. Hurley, Superintendent's office, N. Y. C. R. R., Detroit, Mich. Meetings monthly, Normandie Hotel, Detroit.

Utah Society of Engineers.—Frank W. Moore, 1111 Newhouse Bldg., Salt Lake City, Utah. Regular meetings, 3d Friday in month, except July and August, Salt Lake City.

Traffic News

William A. Colston, general solicitor of the Louisville & Nashville, addressed the Transportation Club of Louisville on June 8, advocating life terms and high salaries for railroad commissioners, and restriction of appointments to men with at least eight years of experience in the railroad business.

Members of the Traffic Club of Chicago made an inspection trip over the Chicago railway terminals on June 15 in a special train, leaving the LaSalle street station over the New York Central, going through the Union stock yards by the Chicago Junction, through the Clearing yard by the Belt Railway of Chicago, then to Blue Island via the Indiana Harbor Belt for inspection of the Indiana Harbor Belt icing plant and returning to the Calumet district via Indiana Harbor, Ind.

According to the Canal Record the earnings from tolls through the Panama Canal for the month of March were greater than the cost of operation and maintenance of the canal by $137,509. This gain reduced the deficit for the fiscal year beginning on July 1, 1914, to $123,588, which represents a loss of 4.09 per cent on the total outlay, not counting anything for interest on the investment or depreciation of the plant. It is stated that the deficit was further reduced during the month of April.

On the petition of the attorney general of Massachusetts, Judge Crosby in the Supreme Judicial Court of the state has issued a temporary injunction against the Boston & Maine and the New Haven railroads, restraining them from breaking a contract of 1912 whereby they agreed to absorb the switching charges on freight to and from the Commonwealth Pier in South Boston. The railroads had filed new rates, effective June 28, which added the switching charges to the straight Boston rates.

Car Surpluses and Shortages

The committee on relations between railroads of the American Railway Association in presenting statistical statement number 5, giving a summary of freight car surpluses and shortages for June 1, 1915, says:

"The total surplus on June 1, 1915, was 295,295, comparing with a surplus of 292,269 on May 1, 1915, and 242,572 on June 1, 1914. The surplus, as shown for May 1, includes figures reported since the issue of statistical statement number 4.

"The increases in surplus over May 1, 1915, are chiefly in groups 3, 5 and 6 (central, north and southeast) and group 10 (west) except coal cars. There is a decrease in the surplus of coal cars chiefly in groups 3 and 5."

The total car shortage on June 1, 1915, was 203, comparing with 966 on May 1, 1915, and 770 on June 1, 1914. The figures by classes are as follows:

Classes	Surplus	Shortage
Box	123,436	55
Flat	14,429	51
Coal and gondola	105,852	73
Other	51,578	24
Total	295,295	203

Cleaning Castings.—In a leading article in the Electrical Review, dealing with lubrication troubles, it is stated that the difficulty with new turbine and engine bearings is frequently attributable to the fact that manufacturers do not clean the castings properly. Castings are never properly cleaned of sand, even externally, by the still common methods of brushing and coke rubbing, and in steam ports and passages it is hopeless to expect cleanliness from such antiquated methods. The most effective way for removing sand seems to be to pickle the castings. First, they are roughly cleaned and fettled and then hosed with weak hydrochloric acid. When sand is present this spreads the acid by capillary attraction, and the result of a few hours of acid action is to remove all sand and to leave the surfaces clean and free from hard siliceous scale. Afterwards the castings are washed with warm water dosed with soda to neutralize any remaining acid.

REVENUES AND EXPENSES OF RAILWAYS

MONTH OF APRIL, 1915

Name of road.	Average mileage operated during period.	Operating revenues			Operating expenses							Net operating revenue (or deficit).	Railway tax accruals.	Operating income (or loss).	Increase (or decr.) comp. with last year.
					Maintenance										
		Freight.	Passenger.	Total, inc. misc.	Way and structures.	Of equipment.	Traffic.	Transportation.	Miscellaneous.	General.	Total.				
Alabama Great Southern	309	$308,859	$71,161	$414,415	$49,750	$96,920	$10,783	$144,993	$2,689	$10,289	$308,303	$106,112	$15,156	$90,941	$48,345
Ann Arbor	294	142,628	37,390	191,563	22,751	27,088	5,707	73,551	320	8,211	137,628	53,936	10,580	43,349	10,995
Arizona Eastern	367	152,575	27,424	190,794	32,085	20,679	1,808	49,827	998	10,667	116,035	74,759	12,460	62,299	—31,496
Atlanta & West Point	93	57,527	32,726	103,646	8,971	19,105	5,469	31,512	1,624	5,067	71,704	31,943	5,525	26,312	17,849
Atlantic & St. Lawrence	167	86,020	25,479	126,915	15,846	16,097	3,394	59,568	.....	3,090	97,996	28,919	10,800	18,119	—868
Atlantic City	170	71,241	72,832	151,215	42,210	17,414	1,563	80,285	83	1,712	143,207	8,008	13,500	—5,724	—5,888
Atlantic Coast Line	4,701	2,073,722	646,352	2,977,165	368,571	412,501	53,964	969,897	10,782	70,784	1,884,164	1,093,002	138,000	954,019	143,707
Baltimore & Ohio—System	4,516	5,823,229	1,020,821	7,430,050	642,769	1,183,443	166,100	2,647,675	50,622	206,553	4,890,381	2,539,669	266,188	2,270,749	213,429
Bangor & Aroostook	631	259,736	50,972	327,342	40,985	46,243	2,216	84,999	2,679	10,003	187,125	140,217	12,525	127,691	—53,169
Bessemer & Lake Erie	205	448,557	22,592	482,155	37,727	154,233	10,796	136,423	.....	12,124	335,258	146,896	17,005	129,892	155,167
Canadian Pacific Lines in Maine	233	111,796	21,449	142,097	14,201	13,471	5,839	47,937	.....	3,871	85,319	56,778	12,000	44,778	—1,458
Carolina, Clinchfield & Ohio	248	161,675	11,635	176,821	21,373	23,635	7,415	35,704	.....	10,621	97,900	78,921	14,250	64,662	—19,281
Carolina, Clinchfield & Ohio of S. C.	18	11,291	890	12,555	1,705	75	1,545	2,095	.....	723	6,143	6,412	750	5,662	—799
Central of Georgia	1,924	687,394	215,001	1,012,351	130,359	161,112	34,231	338,476	2,156	37,866	706,315	306,036	50,297	254,276	129,656
Central of New Jersey	678	2,056,318	403,052	2,585,140	203,605	470,791	27,708	817,648	11,306	49,453	1,580,510	1,004,630	117,447	887,182	272,521
Central New England	304	384,008	32,085	431,869	64,827	35,488	1,461	101,107	.....	4,300	207,139	224,731	16,000	208,731	57,458
Central Vermont	411	227,344	63,079	317,731	33,693	44,636	9,751	141,100	1,325	10,306	240,810	76,920	15,760	61,160	43,064
Charleston & Western Carolina	341	141,568	21,850	172,033	26,474	21,063	3,581	55,403	.....	4,550	111,052	60,981	5,000	55,981	13,269
Chicago & Eastern Illinois	1,282	770,652	201,456	1,065,269	373,097	282,595	25,326	406,249	7,791	35,982	1,128,745	—63,476	53,600	—117,231	—116,236
Chicago & Erie	270	431,563	42,358	516,588	62,329	83,624	16,736	222,039	2,906	15,120	402,506	114,082	20,500	93,582	87,140
Chicago, Burlington & Quincy	9,367	4,541,429	1,450,571	6,689,143	1,522,888	1,233,216	128,544	2,180,327	63,246	164,571	5,292,792	1,396,351	331,020	1,065,331	331,142
Chicago, Detroit & Can. Gd. Trunk Jctn.	60	50,246	12,360	73,225	7,969	10,578	1,522	40,780	.....	1,690	62,540	10,685	2,870	7,815	2,066
Chicago Junction	24	.....	.....	163,616	20,405	21,116	1,943	89,228	.....	6,746	139,439	24,177	2,367	21,660	—9,907
Chicago, Terre Haute & Southeastern	374	143,044	13,749	161,253	17,804	41,238	2,986	48,764	964	9,654	121,410	39,843	12,500	27,343	66,324
Cincinnati Northern	246	105,352	12,524	122,525	21,551	24,088	2,471	39,899	.....	4,348	92,356	30,169	5,500	24,668	25,478
Colorado Midland	338	82,945	10,386	101,710	18,511	26,993	8,712	46,424	952	5,379	106,971	—5,261	10,000	—15,261	—3,524
Denver & Rio Grande	2,575	1,167,197	340,880	1,623,646	139,151	289,369	41,579	467,859	29,927	59,946	1,027,831	595,815	81,600	514,081	152,037
Denver & Salt Lake	255	77,333	18,784	102,667	14,297	16,404	2,363	35,395	.....	4,851	73,079	29,588	7,500	22,088	26,393
Detroit & Toledo Shore Line	79	115,252	.....	115,450	9,904	9,517	1,772	34,448	.....	2,987	58,627	56,824	3,687	53,137	11,879
Detroit, Grand Haven & Milwaukee	191	137,000	35,000	197,193	21,147	31,961	6,178	105,553	571	5,106	170,517	26,676	3,360	21,917	36,663
Detroit, Toledo & Ironton	441	102,322	9,174	118,981	18,244	12,788	3,293	61,340	.....	5,622	101,287	17,694	5,500	12,194	72,501
Duluth & Iron Range	273	221,229	16,547	247,166	50,091	41,321	827	73,833	1,241	9,404	176,717	70,449	12,250	58,199	123,384
Duluth, South Shore & Atlantic	626	141,291	60,410	219,088	38,871	36,612	7,447	87,106	3,737	9,686	183,458	35,630	16,000	19,603	—19,885
Duluth, Winnipeg & Pacific	185	67,506	14,280	83,509	13,152	11,622	1,383	31,249	181	6,333	63,920	19,589	4,175	15,414	—4,137
Elgin, Joliet & Eastern	776	708,411	5	751,150	98,587	115,827	5,676	218,890	.....	22,674	461,655	289,495	40,890	248,374	20,295
Erie	1,988	3,428,510	665,734	4,495,620	413,627	1,218,848	98,909	1,593,377	27,456	126,540	3,467,817	1,027,803	168,654	857,473	—466,745
Florence & Cripple Creek	87	88,372	15,340	105,287	10,099	10,311	2,633	27,042	.....	6,078	56,164	49,123	5,645	43,478	8,345
Florida East Coast	745	318,954	168,907	561,029	49,043	53,605	6,841	149,247	3,045	16,400	275,097	285,932	20,466	265,467	17,203
Fort Worth & Denver City	454	252,846	85,802	362,943	53,235	72,859	5,849	132,779	2,013	15,248	281,983	80,960	12,621	68,340	18,154
Galveston, Harrisburg & San Antonio	1,350	517,636	232,244	826,564	174,633	118,066	30,491	363,750	10,129	33,638	730,378	96,186	39,624	56,402	—36,415
Georgia	307	154,462	52,284	225,709	26,116	54,201	12,249	97,600	347	10,484	200,965	24,745	3,100	21,628	—8,571
Georgia, Southern & Florida	395	102,228	46,283	173,251	23,899	24,582	7,270	71,328	778	10,144	138,002	35,250	10,122	25,075	12,522
Grand Rapids & Indiana	575	277,969	115,624	424,270	54,680	77,681	10,614	174,554	36	14,366	331,931	92,339	21,513	70,826	20,274
Grand Trunk Western	347	441,000	125,000	608,261	71,997	122,946	17,575	247,844	4,503	14,975	479,840	128,421	35,920	92,459	41,873
Great Northern	8,077	3,006,955	916,336	4,449,056	1,374,313	566,288	97,059	1,300,595	57,553	102,739	3,495,112	953,944	325,019	628,667	33,182
Gulf, Colorado & Santa Fe	1,937	865,130	194,451	1,135,973	234,898	177,024	28,187	444,683	.....	32,602	917,147	218,825	45,043	173,716	59,940
Hocking Valley	351	350,615	59,474	442,497	46,976	80,428	8,450	153,640	.....	13,041	302,536	139,961	34,050	105,911	33,431
Houston, East & West Texas	191	87,842	21,482	116,088	14,969	9,898	1,850	40,319	567	3,529	71,128	44,960	4,170	40,790	19,555
Houston & Texas Central	894	296,958	93,002	427,876	110,699	68,506	15,333	186,269	3,890	17,019	400,689	27,187	26,951	165	55,258
Kansas City Southern	827	622,704	95,474	786,066	72,745	85,493	26,595	263,261	.....	36,171	476,108	309,958	48,170	260,422	—15,737
Lake Erie & Western	900	392,618	49,906	463,910	71,535	94,359	13,925	179,591	.....	11,936	371,346	92,564	24,000	68,523	25,657
Lehigh & Hudson River	97	166,739	8,855	177,173	19,692	19,519	1,471	52,462	.....	5,714	98,858	78,315	4,150	74,165	28,749
Louisiana & Arkansas	279	124,626	12,224	140,685	28,549	22,136	3,070	35,398	.....	3,932	93,086	47,599	7,500	40,090	3,836
Louisiana Ry. & Navigation Co.	351	127,664	27,737	165,991	34,357	19,948	6,045	62,724	.....	4,829	127,903	38,087	11,500	26,587	8,570
Louisiana Western	208	104,710	50,193	169,994	45,149	20,364	7,063	53,436	1,581	6,321	133,906	36,087	9,895	26,082	—14,583
Louisville & Nashville	5,034	2,979,499	806,326	4,136,668	823,157	807,511	107,864	1,347,715	16,738	103,908	3,200,098	936,569	160,355	775,880	—14,245
Louisville, Henderson & St. Louis	200	71,737	30,502	109,394	25,763	15,873	5,281	36,357	.....	3,448	86,722	22,673	3,800	18,868	—3,034
Michigan Central	1,800	1,871,956	697,091	2,863,499	343,878	468,376	54,832	1,114,966	41,246	58,260	2,081,559	781,941	121,000	660,554	27,392
Midland Valley	380	57,742	30,515	94,854	22,326	16,880	2,012	35,720	.....	5,377	82,315	12,539	4,749	7,755	6,861
Minneapolis & St. Louis	1,646	568,799	135,116	750,905	94,456	102,685	16,537	291,705	167	22,098	527,648	223,257	31,201	192,050	82,525
Minn., St. Paul & Sault Ste. Marie	4,104	1,454,295	394,557	2,012,634	257,457	333,274	50,186	718,970	12,790	65,299	1,418,279	594,355	79,671	514,684	—92,440
Missouri & North Arkansas	365	62,243	22,701	92,215	32,787	23,709	2,431	50,343	.....	5,767	115,036	—22,821	5,268	—28,183	—25,016
Missouri, Kansas & Texas System	3,865	1,832,157	559,958	2,598,981	401,956	407,457	52,469	956,947	22,497	84,970	1,906,857	692,125	114,880	576,802	68,438
Missouri, Oklahoma & Gulf of Texas	19	7,603	148	8,088	1,281	3,869	177	5,133	.....	396	10,855	—2,767	140	—2,907	—3,999
Missouri Pacific	3,920	1,595,934	348,912	2,128,978	301,886	410,244	49,863	855,808	7,420	56,038	1,681,261	447,717	108,650	333,962	71,591
Monongahela	75	100,018	1,831	103,457	22,023	14,390	379	22,421	.....	2,086	61,298	42,159	1,810	40,349	—31,443
Morgan's La. & Tex. R. R. & S. S. Co.	405	205,480	81,444	317,862	43,935	39,437	11,722	139,154	1,916	11,523	247,528	70,334	20,013	50,173	52,596
Nevada Northern	165	113,118	8,548	124,957	17,997	12,800	489	24,472	14	4,456	60,228	64,729	5,004	59,673	9,421
New York Central Railroad	5,979	8,970,688	3,498,502	14,426,358	1,480,459	2,692,878	263,484	4,623,204	149,671	347,683	9,557,379	4,868,979	824,746	4,043,970	.....
New York, New Haven & Hartford	2,003	2,833,740	2,094,935	5,536,894	776,928	909,091	36,766	1,985,277	49,638	129,597	3,886,241	1,650,653	200,000	1,450,294	332,730
New York, Philadelphia & Norfolk	112	243,244	34,791	299,684	30,988	75,934	3,846	130,198	4,124	11,224	256,315	43,369	9,500	33,869	—23,257

REVENUES AND EXPENSES OF RAILWAYS

MONTH OF APRIL, 1915—CONTINUED

Name of road.	Average mileage operated during period.	Operating revenues — Freight.	Operating revenues — Passenger.	Operating revenues — Total, inc. misc.	Operating expenses — Maintenance — Way and structures.	Operating expenses — Maintenance — Of equipment.	Operating expenses — Traffic.	Operating expenses — Trans-portation.	Operating expenses — Miscel-laneous.	Operating expenses — General.	Operating expenses — Total.	Net operating revenue (or deficit).	Railway tax accruals.	Operating income (or loss).	Increase (or decr.) comp. with last year.
New York, Susquehanna & Western	140	$237,874	$42,776	$308,351	$24,648	$32,544	$2,064	$116,531	....	$8,484	$184,241	$124,110	$13,208	$110,897	$30,606
Norfolk & Western	2,044	3,263,318	358,619	3,759,184	477,374	720,989	60,896	1,036,828	$8,957	75,981	2,363,189	1,395,995	168,000	1,227,922	136,865
Northwestern Pacific	401	90,428	135,457	258,405	42,348	45,559	5,967	108,128	....	7,327	207,333	51,072	15,452	35,619	—6,576
Oregon Short Line	2,162	965,155	323,229	1,424,903	236,617	234,019	32,266	365,478	22,668	52,456	942,058	482,846	114,803	367,699	—234,628
Oregon-Washington R. R. & Nav. Co.	2,027	719,019	306,457	1,132,298	144,714	162,234	39,621	376,276	10,424	59,803	791,266	341,032	102,544	238,168	—37,029
Panhandle & Santa Fe	670	265,911	61,531	343,579	98,016	86,335	3,483	105,854	....	9,363	303,051	40,527	12,082	28,445	—6,063
Pere Marquette	2,312	1,145,153	280,098	1,550,851	187,082	310,526	28,964	565,155	3,686	39,026	1,134,397	416,454	46,831	369,623	287,625
Philadelphia & Reading	1,120	3,544,174	482,894	4,208,399	514,973	710,257	41,443	1,392,736	15,102	69,749	2,743,519	1,464,879	99,603	1,364,813	142,676
Pittsburgh & Lake Erie	225	1,023,287	117,637	1,190,908	110,526	221,212	12,111	288,810	3,201	26,394	662,255	528,653	49,500	479,153	113,092
Pittsburgh, Shawmut & Northern	294	125,043	9,384	136,099	15,779	34,512	2,117	43,399	....	5,464	101,270	34,828	1,611	33,217	39,702
Port Reading	21	101,832	....	125,437	15,619	5,066	38	39,813	....	101	60,637	64,800	12,000	52,800	15,840
Richmond, Fredericksburg & Potomac	88	145,872	92,134	274,134	26,009	32,371	5,343	88,106	5,141	7,556	164,527	109,597	6,476	103,117	1,642
Rutland	468	160,255	96,010	291,281	25,220	48,247	8,757	106,629	987	5,808	195,648	95,634	16,859	78,741	25,085
St. Louis, Iron Mountain & Southern	3,364	1,789,067	371,974	2,338,246	336,528	439,816	62,209	751,245	7,313	75,473	1,672,583	665,663	109,280	552,751	—164,929
St. Louis Merchants' Bridge Terminal	9	....	132	139,982	20,557	6,016	843	72,593	....	5,491	105,500	34,481	6,540	27,937	30,495
St. Louis Southwestern	943	425,261	74,348	536,211	40,632	71,487	23,423	147,713	2,774	23,836	309,750	226,461	39,333	186,995	61,657
St. Louis Southwestern of Texas	810	176,886	52,704	251,924	58,300	50,981	11,362	145,938	574	16,930	250,947	977	15,008	—14,047	77,676
San Antonio & Aransas Pass	724	160,014	64,596	265,810	80,572	54,571	6,316	133,663	....	11,965	287,048	—21,238	14,077	—35,315	—10,053
Southern in Mississippi	281	39,145	21,872	66,625	19,678	7,763	1,802	37,259	....	3,454	69,955	—3,331	8,375	—12,067	—9,979
Spokane International	163	46,267	9,648	58,250	11,773	4,568	2,423	18,983	....	3,159	40,905	17,344	3,861	13,484	—14,424
Spokane, Portland & Seattle	556	162,764	98,647	293,303	102,009	39,109	7,532	80,173	3,083	13,082	244,971	48,331	53,400	—5,442	—110,160
Tennessee Central	294	91,302	28,287	126,903	33,048	15,165	5,538	44,779	....	7,649	106,177	20,725	4,480	16,239	—7,148
Terminal R. R. Ass'n of St. Louis	35	....	200	213,467	17,510	10,187	903	79,932	....	5,006	113,539	99,928	28,168	71,760	53,299
Texas & New Orleans	469	196,795	73,011	300,160	57,526	69,550	7,951	113,174	3,912	9,982	261,732	38,428	15,805	22,545	26,863
Texas & Pacific	1,944	936,495	270,915	1,318,286	166,818	236,039	36,609	697,800	11,084	40,160	1,188,125	131,161	68,700	61,006	—103,449
Toledo & Ohio Central	446	280,881	41,219	340,000	51,533	65,379	6,536	136,020	1,795	10,285	271,548	68,453	21,000	47,238	55,454
Toledo, Peoria & Western	248	40,937	32,091	78,621	16,784	28,437	1,935	44,877	....	3,590	95,623	—17,002	6,100	—23,102	12,183
Toledo, St. Louis & Western	451	317,562	23,710	367,447	43,565	121,150	16,944	139,195	....	7,343	328,198	39,249	17,864	21,385	—38,233
Trinity & Brazos Valley	315	32,741	9,039	48,737	21,452	12,068	2,477	31,912	....	7,256	75,165	—26,428	4,585	—31,227	20,169
Union Pacific	3,617	2,443,923	810,274	3,736,799	561,243	604,161	129,700	943,147	68,209	134,782	2,440,568	1,296,231	193,543	1,102,413	—40,778

Commission and Court News

INTERSTATE COMMERCE COMMISSION

The commission has issued another order, to take effect July 15, requiring that station agents receiving tariffs must note on each the date on which it was received; and must also keep a record of the date that all tariffs and supplements are received; also the date posted.

The Interstate Commerce Commission announces that after July 15 carriers must take care to make no changes in rates which have been ordered continued because the commission decides to suspend and investigate proposed new rates. Until the suspension has expired the rates, practices, etc., which are continued in effect by virtue of the suspension must not be changed in any particular.

Mixed Carload Shipments of Lime, Cement, and Plaster from Interstate to Arkansas Points

Investigation and Suspension Docket No. 554. Opinion by Commissioner Hall.

Proposed withdrawal of tariff provision under which mixed carloads of lime, cement and plaster are shipped "from interstate to Arkansas points" found not to be justified. Tariff withdrawing the provision ordered to be canceled, and carriers required to name such provision by other tariffs, upon the basis of the highest rated commodity contained in the mixture. (34 I. C. C., 124.)

Rates for Warming Potatoes Found Reasonable

Albert Miller & Company v. Northern Pacific. Opinion by Commissioner Hall:

Upon complaints alleging that defendants' rules and charges relating to the protection from cold of potatoes in transit are unreasonable and unjustly discriminatory; it is held that complainants have not shown themselves entitled to relief. Complaints dismissed. Rates 4 to 7 cents per 100 lb. for heating cars held to be fair. (34 I. C. C., 154.)

Erie Retains Chicago Water Craft

Upon applications of the Chicago & Erie and the Erie to continue their interest in and operation of certain tugboats, barges and other equipment used on the Chicago river; the commission, in an opinion by Chairman McChord, holds that the fact that the petitioners are parties to through all-rail route arrangements between the points served by the water equipment here involved makes it possible for the petitioners to compete for traffic with such water equipment within the meaning of the act; but that the service by water is being operated in the interest of the public, and that a continuance thereof will neither exclude, prevent, nor reduce competition on the route by water under consideration. The tariffs of rates applicable via this water route must be filed in accordance with the provisions of the act, to become effective by July 15, 1915.

Rates on Sugar to Arizona

Arizona Corporation Commission v. Atchison, Topeka & Santa Fe et al. Opinion by Commissioner Daniels:

The complaint attacks as unreasonable the rates on sugar and syrup in straight and mixed carloads from producing and refining points in California to all points in Arizona. Subsequent to the hearing the carriers published reduced rates on these commodities to many points of destination in the state. Except as to the rates to Phoenix and Prescott, the evidence does not show that the rates in effect, at the time of the hearing, on sugar and syrup in straight carloads, minimum weight 36,000 lb., were unreasonable to a greater extent than the amounts of the reductions since made. Rates to Phoenix and Prescott ordered to be established for the future upon a basis of not more than 5 cents per 100 lb. higher than the rates to the junction points. No finding is made as to the rates on sugar and syrup in mixed carloads. (34 I. C. C., 158.)

Ownership of San Francisco & Portland Steamship Company

Opinion by Commissioner Clark:

Upon application of the Oregon-Washington Railroad & Navigation Company for an extension of time beyond July 1, 1914, in which petitioner may continue to operate the San Francisco & Portland Steamship Company; it is held that a rail carrier does not necessarily have to reach a point in order to compete for traffic with water carriers that operate directly to that point, but such competition may exist by the rail carriers participating in joint rates. The O.-W. R. & N. does or may compete for traffic with the San Francisco & Portland Steamship Company within the meaning of the act. The operation of the steamships is in the interest of the public, and a continuance of such operation will neither exclude, prevent, nor reduce competition on the route by water. The application should be granted. All the rates and regulations of the steamship company covering traffic subject to the act moved by it in the operations considered herein must be filed with the commission and posted. (34 I. C. C., 165.)

Erie's Boats on Lake Keuka

Application of the Erie Railroad Company. Opinion by Chairman McChord:

Upon application of the Erie Railroad Company for authority to continue its interest in and operation of the Lake Keuka Navigation Company, it is held that the petitioner does not compete for traffic with the said Lake Keuka Navigation Company within the meaning of the act. The Erie Railroad owns the capital stock of the Erie Land & Improvement Company, which company in turn owns the capital stock of the Southern Tier Development Company, which company in turn owns the capital stock of the Lake Keuka Navigation Company, operating four boats serving the ports located on Lake Keuka, in the state of New York, which connect at Hammondsport with the Bath & Hammondsport Railroad, a subsidiary of the petitioner, and at Penn Yan with the central division of the Pennsylvania Railroad and with the New York Central. The navigation company furnishes the only means of transportation for the people living in the territory served. It does not appear that the rails of the petitioner, or any of its subsidiaries, serve the ports located on Lake Keuka in common with its said boats, nor does the petitioner join in through rates with other carriers reaching said ports. (34 I. C. C., 212.)

Rates to Coffeyville and Independence

Coffeyville Mercantile Company et al. v. Missouri, Kansas & Texas et al. Opinion by Commissioner Hall:

Upon reargument, it is held, that no occasion has been shown for modifying the original report and order. This case, reported in 33 I. C. C., at page 122, was reopened upon motion of the defendants and argued May 19. Complainants are wholesale and jobbing merchants at Coffeyville and Independence, Kan. In the original report the commission found that in the jobbing business they are in competition with merchants at Chanute, Parsons, Pittsburg and Fort Scott, Kan., and Kansas City, Mo., and ordered reductions to equalize with rates to Chanute and Parsons, with certain differentials. The chief objection urged by defendants to the original report of the commission is that, as alleged by them, it practically disrupts the rate fabric established in pursuance of the commission's decision in State of Kansas v. A. T. & S. F., 27 I. C. C., 673. But complainants have shown themselves entitled to relief, and such relief should not be denied simply because of the carriers' apprehension regarding the possible consequences. The readjustment tentatively suggested by defendants is manifestly beyond the scope of the present proceeding. The illustrations used to show the possible tendency of our decision herein are interesting, but seem to assume that all rates in this territory will be readjusted upon a differential basis, such differentials, apparently, being computed upon the basis of ton-mile earnings. The reports of the commission do not warrant the assumption that it has adopted such a theory. Nothing presented at the argument shows the occasion for any modification of our report and order in this case. The order requiring the establishment of the rates prescribed on or before June 15, 1915, will be left undisturbed.

Commissioner Daniels dissents. He says that the schedule of rates prescribed in this case is on the whole upon a basis lower than prescribed by the commission in State of Kansas v. A. T. & S. F., 27 I. C. C., 673, and below the scale of state prescribed rates in Missouri. While to some towns the rates reduced in the original report in this case were unjustifiably higher than to other nearby points, there is not sufficient evidence to declare the condemned rates unreasonable *per se*. Commissioner Clements also dissents. (34 I. C. C., 231.)

Southern Pacific Steamboats

Application of the Southern Pacific and the Central Pacific. Opinion by Commissioner Clark:

Upon application of the Southern Pacific Company and the Central Pacific Railway Company, under the provisions of section 5 of the act to regulate commerce as amended by the Panama Canal act, for an extension of time beyond July 1, 1914, during which petitioner may continue to operate boats on the Sacramento river and connecting waters, it is held that the Southern Pacific does not compete for traffic with its boat line; that the operation of the boat line is in the interest of the public and of advantage to the convenience and commerce of the people; that its continued operation by petitioner will neither exclude, prevent, nor reduce competition on the route by water, and that the application should be granted. The rates and regulations of the boat line governing its operations considered herein must be filed as required by the act and the regulations of the commission.

These boats engage principally in the handling of freight and passengers from and to the fruit and vegetable belt west of Sacramento, which, owing to topographical conditions, is, except to a very limited extent, inaccessible to any railroad line and is dependent almost entirely upon river service. There are six steamboats—the Apache, Modoc, Navajo, Fruto, Cherokee and Iroquois.

Fruit is shipped to Sacramento under local charges, consigned to various shipping firms and is there distributed through the medium of distributing organizations. It moves from Sacramento to eastern markets on new bills of lading, and there are no restrictions with respect to the outbound routing of shipments brought in by the boat line. In 1913, there were 149 craft of various kinds operating on the Sacramento river exclusively, and 167 operating in part on the Sacramento river and partly on other rivers, making a total of 316 boats on the Sacramento river, of which petitioner operates 6. The same report shows that for the year ended December 31, 1912, 202,015 passengers were carried by reporting lines, of which petitioner's boats carried 117,000. During the calendar year ended December 31, 1913, petitioner's boats carried 81,421 passengers. The tonnage carried by the four principal transportation companies on the Sacramento river for 1912 was 477,292 tons, of which petitioner's boats carried 109,097 tons, or a little less than one-fourth. There are several regular boat lines, also several irregular lines, in competition with that operated by petitioner. (34 I. C. C., 174.)

Rates on Hay to Chicago

Investigation and Suspension Docket No. 497. Opinion by Commissioner Hall.

Supplements to the Lowrey tariff governing switching in the Chicago, Ill., switching district, by which the Wabash proposes to discontinue its absorption of switching charges in that district on hay in carloads, allowed to become effective. Orders of suspension vacated.

The Lowrey tariff embodies an agreement between some 37 issuing and participating carriers under which they switch carload traffic, with some exceptions, to and from team tracks, industrial plants, warehouses, elevators and other points of destination or origin within the Chicago switching district therein described upon the line-haul rate to Chicago, unless that rate aggregates less than $15 for the carload, in which case the carrier receiving the line haul into or out of the switching district absorbs only so much of the switching charge of its connecting carrier as will leave it the same earning for that car as if it had received $15 for the line haul and paid the entire switching charge. More than 2,000 places in the Chicago switching district are designated by the carriers as points of origin and destination subject to the terms of this tariff.

From the inception of the agreement each issuing carrier has excepted designated commodities. Without enumerating these

it is sufficient to say that at the present time the exceptions made by the various carriers range from 2 to 16. The Wabash maintains 4, viz., coal, coke, grain and livestock, and now proposes to add hay as a fifth.

It alleges that the absorption by it of these switching charges on hay renders its transportation of that commodity to Chicago unremunerative. Records are shown of 77 shipments which originated at points in Missouri, Kansas, Oklahoma, Indiana and Ohio. The hauls averaged 267.6 miles, the rates ranged from 8 to 26 cents per 100 lb. and the average loading was about 25,000 lb. The total revenue received was $2,190, averaging $28 a car; and the total absorption paid was $676, averaging $8.79 a car, or about 31 per cent, leaving an average balance of $19.66 a car, which would yield average ton-mile earnings of 5.9 mills and car-mile earnings of 6.8 cents for the line haul. About 50 per cent of all hay transported to Chicago by the Wabash is there switched to points of delivery on the rails of other carriers.

Hay is delivered from the team tracks of the Wabash at two points only in the switching district. These are somewhat inaccessible, and consequently are not much frequented by purchasers of hay. For this reason it is difficult to sell hay from the team tracks of the Wabash in competition with that sold at points of delivery on other railroads, and hay sold at these points on the Wabash ordinarily brings from 50 cents to $1 less a ton than that sold at downtown team tracks on other lines. The commission merchants testify that, under the proposed supplements, shippers at points of origin on the Wabash will be at a disadvantage as compared with shippers on other lines in marketing their hay in Chicago and will seek other markets, such as St. Louis, Detroit and Cleveland.

The burden of proof of the reasonableness of rates increased after January 1, 1910, is upon the carriers, both as to the total or through charges and the separately established or separately stated charges which make up the total. And it is as much an increase of rate to give less service for the same amount as to charge a greater amount for the same service.

In *Board of Trade of Chicago v. A., T. & S. F.*, 29 I. C. C., 438, it was held that the failure of five carriers to absorb the switching charges on grain delivered to Chicago industries off their lines, while absorbing such charges in the cases of other commodities, did not constitute unlawful discrimination. The proposed cancellation of absorption of switching charges on sand and gravel from points in Wisconsin and Illinois to Chicago, Ill., and points in Indiana within the Chicago switching district was found to be justified. Upon the whole proof presented the respondent has justified the cancellation of the absorption of switching charges proposed by the suspended supplements. The orders of suspension will accordingly be vacated. (34 I. C. C., 150.)

STATE COMMISSIONS

The Public Utility Commissioners of New Jersey have refused to authorize the Fidelity Land Company of Beach Haven Terrace to extend a street across the track of the Barnegat & Beach Haven Railroad, declaring that it is the policy of the state to authorize no more grade crossings of steam railroads except where there shall be shown to be great public necessity.

The Texas Railroad Commission on June 1, resumed its hearing on the application of the railroads of Texas for a general advance in freight rates throughout the state. The case of the railroads was completed at the previous hearing, and this hearing was held to give shippers an opportunity to testify. Most of the shippers who testified last week said they were not opposed to an increase in revenue for the Texas roads, provided the increase be effected by an equal distribution among the different sections of the state, although some protested that the tariffs filed by the railroads would create discrimination against some sections. A series of resolutions was adopted by the shippers in attendance at the hearing that if it is the conclusion of the railroad commission that the present revenues are inadequate "then the measure of such inadequacy shall be justly apportioned over the entire state and on all classes of commodities where it can be consistently done upon some horizontal, or even percentage basis of distribution." Representatives of the railroads then presented a resolution endorsing this proposal and stating that the carriers would offer no objection to the plan, with the exception of a few items in the tariffs on which they wish to proceed with the hearing on the original plan. An agreement on these resolutions would remove from the controversy 29 of 37 subjects docketed for the hearing.

No More Temporary Doors

The New York State Public Service Commission, Second district, has refused to allow the railroads to cancel their regulation under which they supply temporary doors or bulkheads for freight cars. Tens of thousands of cars of potatoes and cabbages are annually shipped from western New York to the metropolitan markets and the practice of shipping apples and other perishable and semi-perishable produce is rapidly growing. Salt also comes under this regulation.

In an opinion by Commissioner Frank Irvine the Commission discusses at length the mechanical, economic and legal phases of the case. The present regulations were put into effect by an order of the Commission in 1909. Commissioner Irvine says that the broad question involved is whether these doors and bulkheads appertain to the car, which the carrier under common law and statute must furnish, or to the proper packing of the commodity to be shipped, which it is the duty of the shipper to supply. He finds that under a Court of Appeals decision they belong to the car. Referring to the practice of some of the western roads in equipping cars with permanent bulkheads and inside rigging, Commissioner Irvine finds that where the shippers are required to furnish this equipment for large shipments it is a total loss to them, while the railroads can recover it and use it again at small cost. Distinguishing these tariffs from dunnage allowances and lumber stakes—which the shippers must pay for—the opinion says that the latter are for a particular class or classes of shipments and are governed by particular conditions, while the demand for the equipment involved in this case is for a large general and growing class. If these equipments encourage delay in unloading through the practice of consignees in selling directly from the car the proper remedy of the roads is in demurrage and track storage charges. As to the allegation that but ten per cent. of the produce shipments are wholly intrastate and that the continuance of the allowances would be discriminatory against the roads reaching New York through New Jersey and Pennsylvania, Commissioner Irvine says that these roads have heretofore met this condition and will continue to do so. He says that recent decisions of the Interstate Commerce Commission, while not involving the exact point here involved, make use of the same reasoning and arrive at substantially similar results.

COURT NEWS

The Supreme Court of the United States has affirmed the decision of the Supreme Court of Pennsylvania against the Pennsylvania Railroad in the case of the Mitchel Coal & Coke Company, of Cambria, which had secured a verdict of $20,000 against the railroad company for alleged unlawful discrimination in the allowance of rebates.

The Supreme Court of the United States, taking a view contrary to that of the Supreme Court of Minnesota has annulled an order of the Minnesota Railroad & Warehouse Commission directing the Great Northern to install at Bertha, Minn., a platform scale for weighing livestock. It is held that the order was both arbitrary and unreasonable.

The New York State Court of Appeals, in a decision by Judge Hiscock, on a complaint by William R. Hearst, who resides on Riverside Drive, New York City, near the freight tracks of the New York Central Railroad, decides in substance that the smoke nuisance must be abated, and that the nuisances of noise due to switching of freight trains and offensive odors due to the practice of leaving cars of livestock standing a long time near residences, must be kept within reasonable bounds. The language of the opinion seems to indicate that Judge Hiscock intends not to condemn absolutely any of the practices of the road which were complained of; but only requires a high degree of care in avoiding excesses.

The New York State Court of Appeals has decided in favor of the railroad company in the suit against the New York, New Haven & Hartford to enforce an order of the Public Service Commission, Second district, annulling an advance in suburban fares made in 1910, the decision being on substantially the same grounds as those set forth in the similar suit against the New York Central, the decision in which was reported last week, page 1261.

In both of these cases the counsel for the Public Service Commission contended that the Public Service Commissions law of 1907 aimed to forbid such a review of the Public Service Commission's orders, as the orders in these cases were subjected to. Judge Cardozo dissented, in both the New York Central and the New Haven cases, but he wrote no opinion.

During the pendency of the suit the railroad has collected the higher rates, but with each sale has given thhe passenger a conditional rebate check. These checks will now become wastepaper.

Stipulation Against Riding in Car with Cattle

A contract for the shipment of livestock, provided that the person in charge should remain in the caboose while the train was in motion, and that a failure to do so should be prima facie evidence of negligence. It also stipulated that the responsibility of caring for the stock should be upon the person in charge. It is held by the Missouri Supreme Court that the latter stipulation did not authorize or require the person in charge to ride in the car with the stock, so as to allow a recovery by his widow for his death in a derailment while so riding. Rawlings v. St. Louis & S. F. (Mo.), 175, S. W., 935.

Crossing Accident—Contributory Negligence

In an action for personal injuries to the plaintiff it appeared that she started to walk across the tracks at a crossing in the city. Three tracks ran north and south; the one to the east being a storage track, the second a siding track, and that to the west a main single track. The plaintiff was familiar with the crossing, and testified that when she approached from the east there were coal cars standing on both the first and second tracks, close to the crossing on both sides, those on the second track being part of a train which had been separated; that before crossing each of these tracks she stopped, looked and listened, but could not see in either direction on account of the cars; that she heard nothing, except the puffing of an engine at her right (north); that as she passed over the second crossing she stooped forward to look to the northward, when she was struck by the overhang of an engine or its tender which was backing from the south. The distance between the rails of the second and main tracks was 7 ft. The Circuit Court of Appeals, second circuit, on a second appeal, held that on the evidence the question of contributory negligence was for jury, and affirmed judgment for plaintiff. New York, S. & W. v. Thierer, C. C. A., 221, Fed. 571.

Discharge of Railroad Employees—Proposed Legislation Criticized by Justices

In reply to questions put by the Senate of Massachusetts in respect to a pending bill which would prohibit railroads from discharging an employee by reason of information touching his conduct until after he has been given an opportunity to make a statement in the presence of the person furnishing the information, the justices of the Supreme Judicial Court of that state are of opinion that the proposed statute would violate the fourteenth amendment, prohibiting the state from depriving any person of life, liberty, or property, without due process of law. The right to contract, or to purchase or sell labor is part of the "liberty" guaranteed thereby. It would also violate the Massachusetts constitutional guaranties of the right to acquire, possess and protect property, which right includes the right to make reasonable contracts which will be under the protection of the law.

They consider that the proposed statute, having no reference to the safety of the traveling public, and applying only to one kind of carrier, "imposes a burden on railroads from which all other common carriers and employers are free. It singles out railroad employees and confers on them immunities and advantages enjoyed by no others who work for individuals and corporations, in a particular which has no relation to the kind of employment engaged in by them. In both respects it tends to destroy equality. It creates of railroad employees a specially privileged class, and subjects railroads, as to a matter having no special relation to their business, as distinguished from other kinds of business, to obstacles and burdens from which other employers are free. There is strong ground for the conclusion that the selection of railroads as the sole object of severely criminal legislation as to a matter having no particular relation to the management of railroads would be arbitrary and hence unwarrantable under the Constitution." *In re* Opinion of the Justices, 108 N. E., 807.

Railway Officers

Executive, Financial, Legal and Accounting

Charles A. Murray, assistant tax commissioner of the Northern Pacific, at Tacoma, Wash., has had his title changed to western tax attorney and commissioner.

Julian M. Bamberger, vice-president of the Salt Lake & Ogden, has been elected president and general manager, with headquarters at Salt Lake City, Utah, succeeding his father, Simon Bamberger, who resigned at the annual meeting. J. B. Bean, secretary and treasurer, was elected vice-president and treasurer, and E. J. Vail was elected secretary.

Operating

J. H. Nuelle, chief engineer of the New York, Ontario & Western, has been appointed also assistant general superintendent.

R. W. Howard, general manager of the New Orleans Great Northern has resigned. The duties of general manager will be performed by W. E. Farris, third vice-president, with office at New Orleans, La.

J. C. Tucker, whose appointment as assistant to the vice-president of the Erie, has previously been announced in these columns, began railway work in 1879 as a station helper on the Buffalo & Southwestern, now a part of the Erie. He became telegraph operator in 1880, and station agent in the following year. In 1883 he was transferred to the division headquarters and after six months' work there was appointed train despatcher. In 1887 he was made trainmaster, and in 1890 assistant trainmaster of the Buffalo division and branches of the Erie and of the Buffalo & Southwestern. The following year he was made trainmaster of that district. In May, 1901, Mr. Tucker was appointed superintendent of the Rochester division of the Erie, and in October of the following year superintendent of the New Jersey & New York, Greenwood Lake, Northern Railroad of New Jersey and branches, all of these being parts of the Erie. In May, 1903, he was appointed assistant superintendent of the New York division of the Erie, and in December, 1904, was made superintendent of the Alleghany division, and the following year had his authority extended over the Bradford division. He was transferred as superintendent to the Rochester division in 1907, and was made general inspector of transportation of the Erie on June 1, 1907. The following year he was made special representative on the general manager's staff and was appointed assistant to the general manager in January, 1914.

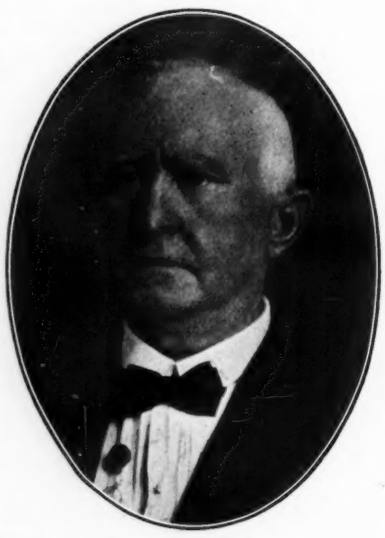
J. C. Tucker

A. A. Iams, whose appointment as superintendent of the Wellston-Delphos division of the Cincinnati, Hamilton & Dayton, with headquarters at Dayton, Ohio, has been noted in these columns, was born on January 31, 1874, at Englewood, Ohio, and received a common and high school education at that place. He entered railway service on December 15, 1890, with the Cincinnati, Hamilton & Dayton as yard clerk and operator at Dayton, Ohio, and has been with that company ever since. In 1898, he was made train despatcher at Wellston, Ohio, which position he held until 1905, when he was made chief train despatcher at the same place. In 1912, he was appointed trainmaster at Dayton, Ohio, from which position he is now promoted.

J. M. Cameron, whose appointment as general superintendent of the Alberta division of the Canadian Pacific, with headquarters at Calgary, Alta., has been announced, was born in December, 1867, and entered railway service in August, 1883, with the Canadian Pacific. He started as wiper, and was later made pumpman. He then went into the operating department as brakeman, from which position he resigned in 1888 to go with the Northern Pacific. In 1900, he re-entered the service of the Canadian Pacific as brakeman, and was soon made conductor, and later trainmaster at Nelson, B. C. He was then appointed superintendent at Moose Jaw and Medicine Hat, and on January 1, 1915, was appointed assistant general superintendent of the British Columbia division, from which position he is now promoted.

J. M. Cameron

John Charles Hagerty, who has been appointed general agent of the Baltimore & Ohio Southwestern, with headquarters at Cincinnati, Ohio, was born on May 4, 1854, at Cincinnati, Ohio. He entered railway service in 1869 with the Ohio & Mississippi as water boy, and in 1870, he worked as track laborer. He was promoted to foreman in 1872, and was employed as a switchman in 1874. Later in the same year he became a telegraph operator, having studied telegraphy at night, and in January, 1883, he was made train despatcher. He left railway service for a while, being engaged in newspaper work until March 9, 1893, when he was made chief despatcher of the Baltimore & Ohio Southwestern, which had absorbed the Ohio & Mississippi. On January 1, 1900, he was appointed trainmaster, and in October, 1904, was appointed superintendent of the Indiana division, with headquarters at Seymour, Ind., from which position he is now promoted.



J. C. Hagerty

Traffic

Alfred J. Ball has been appointed to the new position of eastern superintendent of the Empire Line of the Pennsylvania Railroad, with office at Philadelphia, Pa.

D. M. Bowman, assistant general passenger agent of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed general passenger agent, with office at Cincinnati, succeeding H. J. Rhein, resigned.

J. G. Smith, chief clerk in the general passenger office of the Missouri, Kansas & Texas of Texas, has been appointed general baggage agent, with headquarters at Dallas, Tex., succeeding W. A. Kellond, who has been transferred to Parsons, Kan., as general baggage agent of the Missouri, Kansas & Texas.

George M. Ball, manager of the Empire Line of the Pennsylvania Railroad, is to retire on June 30, under the pension regulations. The management of the Empire Line will be thereafter vested in the freight traffic manager. George M. Ball was born in Philadelphia in 1845. He began railroad work in 1868 with the Empire Transportation Company, and was made eastern superintendent of the company at Williamsport, Pa., in 1871, and was made manager of the Empire Line in 1881.

Engineering and Rolling Stock

Roy W. Bond, superintendent of shops of the Boston & Maine at Concord, N. H., has been appointed general mechanical shop inspector, with office at Boston, Mass. Mr. Bond will report to the superintendent of motive power.

G. E. Sisco, whose appointment as master mechanic of the Toledo and Marietta divisions of the Central system of the Pennsylvania Lines West, has already been announced in these columns, began railway work in June, 1901, at the Fort Wayne shops of the Pennsylvania, Fort Wayne, Ind. At the end of the summer he returned to Johns Hopkins University, graduating in 1902, and again went to the Fort Wayne shops, this time as special apprentice. He was made foreman in 1906, and in September of the same year was transferred as foreman to the Allegheny shops. In June, 1910, he was appointed assistant master mechanic at the Allegheny shops. In January, 1912, he was made assistant engineer of motive power of the Southwestern system of the Pennsylvania Lines, with office at Columbus, Ohio, holding this position until his appointment as master mechanic.

W. H. Keller, whose appointment as master mechanic of the Baltimore & Ohio Southwestern at Cincinnati, Ohio, has already been announced in these columns, began railroad work on the Baltimore & Ohio as engine wiper in 1886. In the following year he became machinist apprentice on the Baltimore & Ohio at Keyser, W. Va., serving four years. He served as machinist at Keyser, at Cumberland, Md., and Grafton, W. Va., from 1891 to 1897. In that year he was appointed foreman at Jayenn, W. Va., and was later foreman at Wiston, W. Va., general foreman at Fairmont, W. Va., and later general foreman at Storrs. In 1912 he was transferred as general foreman from Storrs to Flora, Ill., and in 1914 was appointed division foreman of the Cincinnati, Hamilton & Dayton at Dayton, Ohio. In April, 1914, he was made acting master mechanic of the Cincinnati, Hamilton & Dayton at Indianapolis, and in February, 1915, was made assistant master mechanic at Cincinnati, which position he held when appointed master mechanic for the Indianapolis division of the Baltimore & Ohio.

H. R. Carpenter, whose appointment as assistant chief engineer of the Missouri Pacific-Iron Mountain System, with headquarters at St. Louis, Mo., has been announced, was graduated from the engineering course of Yale University in 1883. He entered railway service in 1884, working as rodman in the engineering department of the Union Pacific, and remained with that company for seven years, the last three of which he was in charge of location and construction work in the west. In 1891 he entered the service of the Denver & Rio Grande, and was engineer in charge of work in Colorado, New Mexico and Utah for four years. He left railway service at this time and went into private practice in Colorado for a period of four years. He then re-entered railway service and for the next four years was chief engineer of the Colorado Springs & Cripple Creek District Railway. He again went into private practice in Colorado for two years. In February, 1905, he was appointed assistant engineer of the Missouri Pacific-Iron Mountain System, in which capacity he worked for seven years. In 1912 he was appointed engineer of maintenance of way, with headquarters at St. Louis, Mo., and remained in that position until his recent promotion.

OBITUARY

Oliver Snyder, division superintendent of the Gulf, Colorado & Santa Fe, at Cleburne, Tex., died on June 6, in that city at the age of 45 years.

Charles Howard, formerly purchasing agent of the Chicago & North Western, died in Chicago, on June 13, at the age of 77 years. Mr. Hayward was born on October 15, 1837, entered railway service in 1879 with the Chicago & North Western, and was purchasing agent for many years.

Equipment and Supplies

LOCOMOTIVE BUILDING

THE CHICAGO GREAT WESTERN has ordered 5 switching engines from the Baldwin Locomotive Works.

THE SOUTHERN RAILWAY has ordered 2 Mikado type locomotives from the Baldwin Locomotive Works.

THE RED RIVER & GULF has ordered one ten-wheel type locomotive from the Baldwin Locomotive Works.

THE LIMA LOCOMOTIVE CORPORATION has received an order for eight Mikado locomotives from the Denver & Salt Lake.

THE WACCAMAW LUMBER COMPANY, Chevy Chase, Md., has ordered one Prairie type locomotive from the Baldwin Locomotive Works.

THE BALDWIN LOCOMOTIVE COMPANY has received an order from the Russian government for 250 locomotives for shipment within six months. The total price is said to be about $6,000,000.

THE RUSSIAN GOVERNMENT, it is understood, has in addition to the order for 250 locomotives from the Baldwin Locomotive Works ordered 100 locomotives from the American Locomotive Company and 50 locomotives from the Canadian Locomotive Corporation.

CAR BUILDING

THE QUANAH, ACME & PACIFIC is making inquiries for 25 40-ton box cars.

THE NORFOLK & SOUTHERN has ordered 24 ballast cars and one parlor car from the American Car & Foundry Company.

THE CHICAGO, ROCK ISLAND & PACIFIC receivers will apply to the court for permission to buy 4,000 freight cars, and will ask the court to rule on the method of financing this purchase.

It is understood that the Russian government has closed contracts for 22,000 cars as follows: 2,000 from the American Car & Foundry Company; 7,000 from the Pressed Steel Car Company; 3,000 from the Canadian Car & Foundry Company; 2,000 from the Eastern Car Company of Canada, and 8,000 from the Seattle Car Company.

SIGNALING

The New York, New Haven & Hartford has authorized an expenditure of $600,000 for the installation of automatic block signals on its line, four-track, from Stamford, Conn., westward to the New York Central connections at Woodlawn, New York City, twenty miles. The controlled manual block system is now in use on this part of the road.

NO NAMES MENTIONED.—The New York Central Passenger Bulletin (L. F. Vosburgh, G. P. A.) has the following note concerning tickets for children: "We urge our ticket agents and doormen to be particular to see that the parents or guardians traveling with children between five and twelve years of age purchase half-fare tickets, and those over twelve full-fare tickets. We won't mention any names, but some agents and doormen 'pass the buck' to the conductors, and leave to the latter the necessity of explaining the rules and making cash collections on the train. This is a bad thing to do, as it opens the way for embarrassment on the part of the conductor and passenger, which, in the interests of all concerned, should be avoided. This hint as to the exercise of greater care on the part of ticket agents and doormen, who should whenever necessary tactfully call attention to the ticket requirements, will, we feel sure, have the desired result."

Supply Trade News

The Robinson Connector Company, of Washington, D. C., is about to move its main office to 187 Church street, New Haven, Conn., where the works of the company are located.

Joseph Battle has been appointed district sales manager, with office at Denver and territory including New Mexico, Colorado, Wyoming and the western portion of Nebraska, of the Terry Steam Turbine Company, Hartford, Conn.

J. B. Evans, engineer of sales installations of the General Railway Signal Company of Canada, Ltd., Montreal, Quebec, has left that company to become general manager of the National Concrete Machinery Company, Madison, Wis.

The Industrial Works, Bay City, Mich., have discontinued their Pittsburgh office. They now have agencies in New York; St. Louis, Mo.; Birmingham, Ala.; Montreal, Canada; San Francisco, Cal.; Los Angeles, Cal., and Seattle, Wash.

Willis C. Squire & Co., recently sold and delivered three automatic track inspectors to the Chicago Great Western. This road has had one of these inspectors in service on its lines for the past four years, and additional machines are required in order that track records can be made up for all divisions of the road.

Charles E. Chinnock, formerly vice-president and general manager of the Edison United Manufacturing Company, New York, died at his home in Brooklyn on June 12, at the age of seventy. Mr. Chinnock was at one time chief electrician of the Metropolitan Telephone Company, predecessor of the New York Telephone Company.

TRADE PUBLICATIONS

GAS AND GASOLENE ENGINES.—The Chicago Pneumatic Tool Company has issued a booklet describing its class A. G. "Giant" gas and gasolene engines. The book illustrates these engines in six sizes ranging in horsepower from 16 to 130.

AIR COMPRESSORS.—Ingersoll-Rand Company has recently issued a well illustrated pamphlet descriptive of the Ingersoll-Rogler steam driven single stage straight line air compressors. The illustrations show details of the machines in sections.

LOCOMOTIVE CRANES AND GRAB BUCKETS.—The Orton & Steinbrenner Company, Chicago, has recently issued its catalog No. 11, describing in detail the different types of cranes and grab buckets, and illustrating them in a wide variety of uses. Considerable data is also given regarding the capacities of various types of cranes under different conditions.

TRACTORS.—The Knox Motors Associates, Springfield, Mass., have just published a 16-page, well illustrated booklet setting forth the principles which apply in the hauling of heavy loads by tractors. There is also a very well illustrated discussion of the Knox tractor from the engineer's point of view and a brief set of specifications of the Knox model 35 tractor.

ELIMINATING GERMAN SHAREHOLDERS.—The directors of Pintsch's Patent Lighting Company, Ltd., an English company, regarding it as essential to eliminate from the company the only remaining connection, viz., the holding by German shareholders of a portion of the capital, have decided upon voluntary liquidation, and a resolution giving effect to that decision has been passed by the shareholders. The necessary permission to form a new company has been obtained. This new company will be registered under the name of the Patent Lighting Company, Ltd., and will consist entirely of shareholders of British nationality, the direction, management and staff being entirely British, as was the case in the old company. The new company will take over the assets of the old company, which include all the patent rights, and will carry on its business without intermission, all goods supplied being of British manufacture.—*Railway Gazette.*

Railway Construction

Bayfield Transfer Railway.—This company contemplates extending its line to Cornucopia, Herbster and Port Wing, Wis., along the south shore of Lake Superior, with Superior, Wis., as the ultimate western terminal. H. C. Hale, Bayfield, Wis., is secretary and general manager.

Illinois Central.—This company has started its track elevation work between One Hundred and One Hundred and Eleventh streets, at Chicago, Ill. The paving and sewer contract has been awarded to the Contracting and Material Company, Chicago, and the general concrete contract was awarded to John J. O'Heron & Co., of Chicago. The contract for the slabs has been awarded to the C. F. Massey Co., Chicago.

Northern Pacific.—This company will lay track on a grade that was constructed last year south of Beach, N. D., a distance of 26½ miles.

RAILWAY STRUCTURES

Albuquerque, N. M.—The Atchison, Topeka & Santa Fe is installing an 800-ton Fairbanks, Morse & Company mechanical coal chute at a cost of $20,500. It has also purchased two locomotive cranes for use at this point.

Amarillo, Tex.—See Wellington, Kan.

Bloomfield, Ind.—The Illinois Central will build a bridge over the White river near Bloomfield, Ind. It will be built of 52-ft. deck plate girder spans, which are now being taken from viaducts in the Hyde Park district of Chicago. It will also have a concrete pile trestle at each end. The masonry contract has been awarded to the Widell Construction Company of Minnesota, and the rest of the work will be done by company's own forces.

Deming, N. M.—The Atchison, Topeka & Santa Fe is enlarging its fruit icing plant at this place at a cost of about $3,500.

Florence, Kan.—The Atchison, Topeka & Santa Fe is installing a Fairbanks, Morse & Company mechanical coal chute at this place at a cost of $18,500. It is also making some changes in the yard and laying some additional track which will cost about $33,000.

Nonconnah, Tenn.—The Illinois Central will build some wooden car repair shop buildings at this place. The estimated cost of these new repair shops is about $150,000. Detail plans have not yet been prepared.

Philadelphia, Pa.—An officer writes that the Pennsylvania Railroad will increase the storage capacity of the grain elevator at Girard Point. The elevator, which was finished one year ago, has a capacity of 1,100,000 bushels, and it is planned to build additional bins to hold 1,000,000 bushels.

Prescott, Ariz.—The Atchison, Topeka & Santa Fe is constructing a seven-stall brick engine house at this place. The work has been begun.

St. Paul, Minn.—In addition to the 250-ft. counter-balanced swing span of the Chicago, St. Paul, Minneapolis & Omaha bridge, noted in the *Railway Age Gazette,* June 11, there are one 70-ft., six 80-ft., one 90-ft. and one 100-ft. deck plate girder spans requiring a total of 1,150 tons of steel. The contract for fabricating the girder spans was awarded to the Chicago Bridge & Iron Works, Chicago, Ill., and for the sub-structure was awarded to Guthrie & Company, St. Paul, Minn. A total of 2,774 cu. yd. of concrete, 45,696 ft. B. M. of timber, and 6,384 lineal ft. of piling are required. The total estimated cost is $225,000.

Wellington, Kan.—The Atchison, Topeka & Santa Fe is installing 100-ft. turntables at this point and at Amarillo, Tex. The cost of each is about $13,000.

Railway Financial News

Alabama & Mississippi.—This company has leased the Pascogoula Moss Point Northern. The Pascagoula Moss Point Northern runs from Pascagoula to Evanston, 42 miles. The Alabama & Mississippi runs from Vinerga Bend, Ala., to Leaksville, Miss., 17 miles.

Chicago, Rock Island & Pacific.—The Wall Street Journal says in regard to the petition which N. L. Amster has made to intervene in the Chicago, Rock Island & Pacific receivership that: "Judge Carpenter did not formally deny the petition of N. L. Amster to intervene in the Rock Island receivership, but strongly intimated that he would."

Cincinnati, Hamilton & Dayton.—The plan for the reorganization of the Cincinnati, Indianapolis & Western, which company is controlled by the Cincinnati, Hamilton & Dayton, has been approved by the bond holders' committee, of which William A. Read is chairman. The plan provides for a new company to have $12,000,000 first mortgage, 5 per cent 50 year bonds; $7,500,000 non-accumulative preferred stock and $7,500,000 common stock. The cash requirements are estimated at $4,053,200.

Grand Trunk.—This company has sold in London, with the permission of the British government $12,500,000 five-year 5½ per cent bonds at 99.

Missouri, Kansas & Texas.—E. R. Tinker, Jr., vice-president of the Chase National Bank, New York, has been elected a director of the Missouri, Kansas & Texas, succeeding George W. Davison, vice-president of the Central Trust Company, resigned.

Missouri, Oklahoma & Gulf.—It is reported that this company has made a trackage agreement for twenty-five years with the Houston & Texas Central and St. Louis Southwestern, which will give it an entrance into Fort Worth from Denison, Tex.

New York, New Haven & Hartford.—Judge William H. Hunt in the United States District Court has handed down the ruling that John L. Billard, who was under indictment for violation of the Sherman Anti-Trust Law in connection with the transfer of the Boston & Maine stock to the Billard Company, cannot be compelled to stand trial because he is entitled to immunity because of his testimony taken at Washington in the Interstate Commerce Commission's investigation of the New York, New Haven & Hartford case.

St. Louis Southwestern.—See Missouri, Oklahoma & Gulf.

The Houston & Texas Central.—See Missouri, Oklahoma & Gulf.

The Future of the Belgian Railways.—A great deal of attention has lately been given to plans for the rebuilding of Belgium. So far there has been little talk of the future of the Belgian railways, a matter which will also have to be taken in hand. The Belgians themselves destroyed points and signals and bridges as much as possible in order to render the lines useless to the Germans. It is improbable that much further damage has been done since the German occupation, but it may be taken for granted that when the German army is forced to evacuate Belgium, it will inflict as much destruction as possible, out of vindictiveness, as well as for the purely strategic reasons that always cause a retreating army to cut the lines of communication at its rear. In addition, the aggregate financial loss due to the destruction and looting of locomotives and rolling stock must amount to a very large sum. As Belgium's industrial and commercial revival will depend on the existence of adequate means of transport, it is obvious that an appreciable proportion of such war indemnity as Germany is made to pay will have to be devoted to the restoration of the Belgian railway system. Incidentally, it would be a very practical form of indemnity if Germany were made to surrender locomotives and rolling stock of an equivalent value and amount to those looted and destroyed during the war.—*Railway Gazette.*